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COVER PICTURE

The Murchison River between Ajana and its estuary flows to a long horseshoe shape gorge which varies in depth from 100 to 250 feet. Although lying or situated close to the road to the Murchison estuary this gorge is but rarely seen by the tourists because of the intervening sandy country and absence of tracks. It could form a distinctive tourists' attraction to its already popular area.

(Photo by C. A. Gardner.)

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KIMBERLEY RESEARCH STATION

A Progress Report

(Prepared by the Supervisory Committee* of the Kimberley Research Station, September, 1960)

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VII. CONCLUSIONS AND FUTURE WORK

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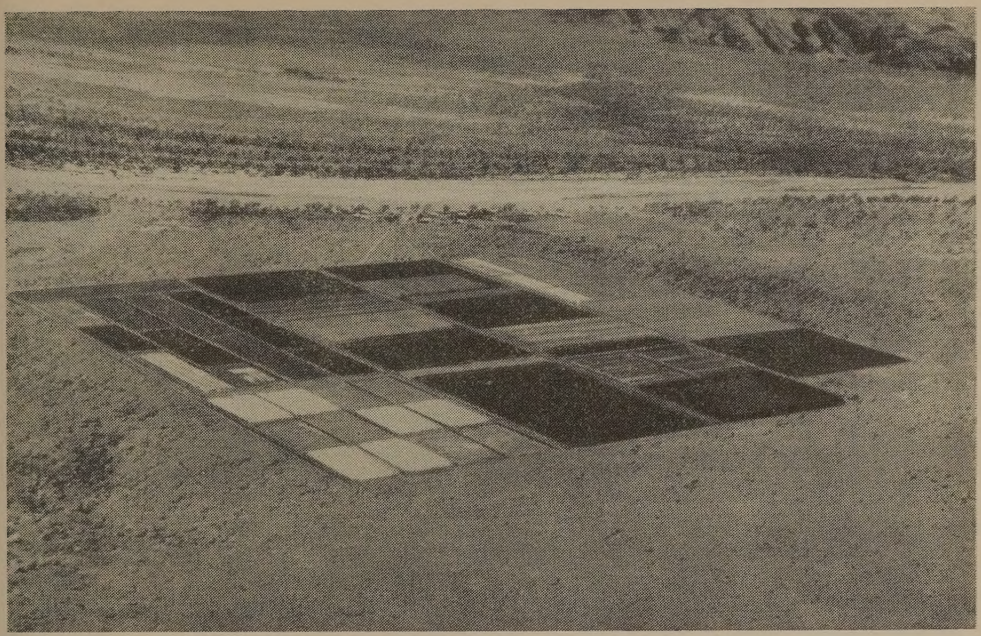


Aerial view of Kimberley Research Station experiments with homestead area in the background. The uncleared country in the foreground is typical of the extensive black soil plains available for irrigation. Ivanhoe air strip can be seen across the river

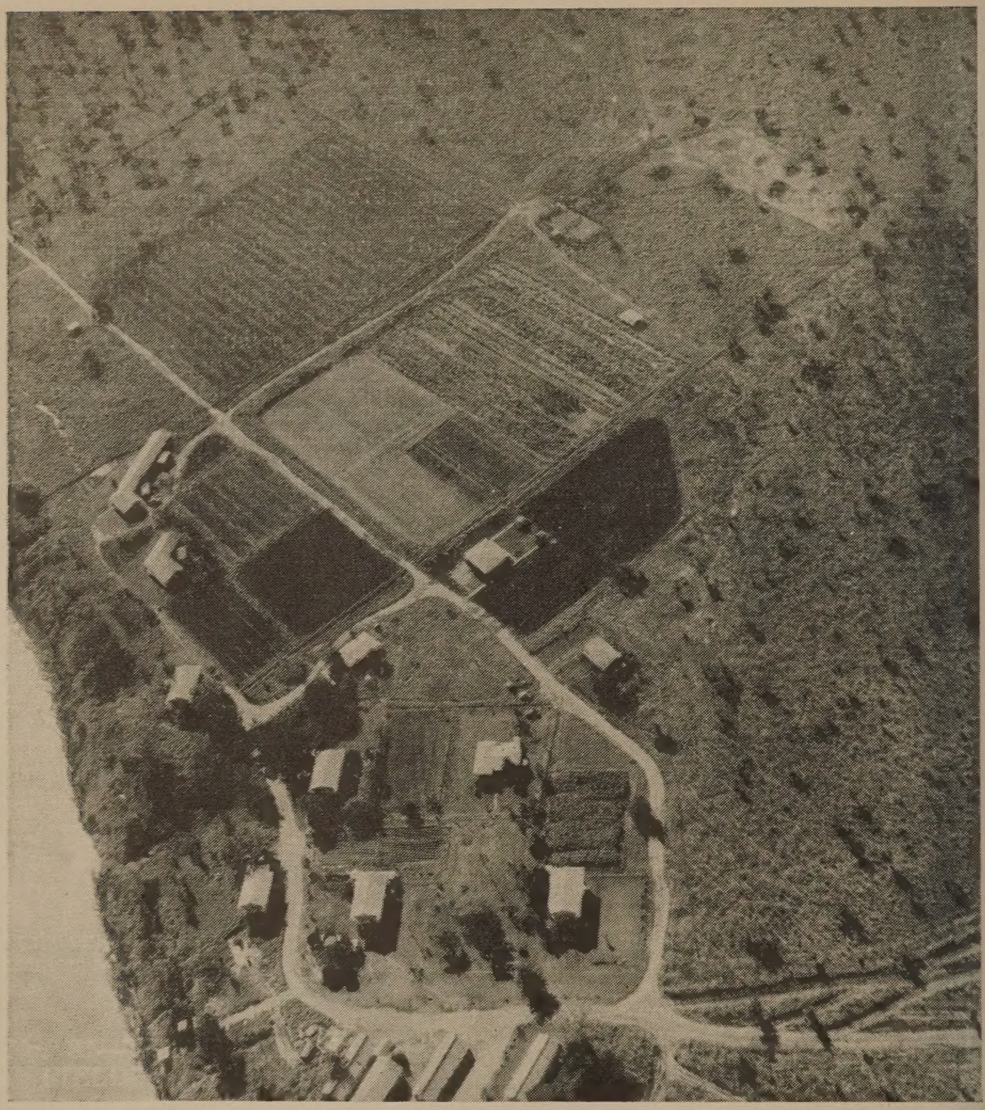
KIMBERLEY RESEACH STATION

A Progress Report

I.—INTRODUCTION

INTEREST in the agricultural potential of the Kimberley region in Western Australia dates from its early exploration and settlement in the last century. Several farming development schemes were considered for the area, but were never implemented. This could be mainly attributable to lack of knowledge of agricultural potentialities, limitations of the local environment and ways of exploiting the local environment. Up to the present the economy of the region is almost entirely based upon the extensive production of beef and to a lesser extent, wool.

Since the last war, when preliminary studies by Dumas (1944) revealed the existence of excellent dam sites on the Ord River, interest in the region's development has been largely centred on the irrigation possibilities of the Ord valley. A study of the river's hydrology and means of harnessing its waters for irrigation and power was carried out by the Public Works Department of Western Australia. To determine the extent of irrigable areas, soil and topographical surveys were undertaken by officers of the Western Australian Government and C.S.I.R.O. Finally, research into the problems of irrigated farming in the area was undertaken at the Kimberley Research Station, operated jointly since 1947 by the Western Aus-



Aerial view of Kimberley Research Station homesteads and garden area on the bank of the Ord River. Workshops and pumping station are in the foreground

tralian Department of Agriculture and C.S.I.R.O.

These studies culminated recently in proposals put forward to dam the Ord River to provide a storage reservoir of 3½ million acre feet and a hydro-electric potential equivalent to 110,000 KW. The proposals also include the construction of a diversion weir below the main dam to command by gravity an area of 200,000 acres found suitable for irrigation (Anon., 1960).

It is proposed that the project be implemented in stages. The implementation of the first stage, regarded as a pilot scheme where the soundness of the project as a whole can be determined, has already been

approved and the work is in progress. This stage involves the construction of a diversion weir, which, until the main dam is built, will serve as a small dam providing storage for 80,000 acre feet, sufficient to irrigate up to 20,000 acres.

This paper is concerned with the achievements and problems of the Kimberley Research Station, which has provided the agronomic data leading to the development proposals.

The station lies at 15° 7′ S. lat., and 128° 7′ E. long., about 100 feet above the mean sea level. The climate of the area is characterised by a warm dry winter season and a hot wet summer season. Rainfall is virtually confined to the summer, most of it falling between early December and mid-March (Table 1). Mean annual rainfall amounts to nearly 30 in., but both quantity of rain, its distribution and the length of the rainy season are very variable. Theoretical moisture balance studies (Slatyer, unpublished data) and early field experiments have shown that in spite of the comparatively high mean annual rainfall, rain grown crops are liable to suffer serious water stresses almost every year. Irrigation is therefore a prerequisite for successful production of most crops. Temperatures in the region are suitable for a wide range of tropical and sub-tropical crops, although growth and development during the cool months is often retarded.

The predominant soil type in the potentially irrigable areas, and the one on which work described here was carried out, is an impermeable clay underlain at various depths by lighter material. Its pH varies from 7.5 to 9.5 but salt and sodium content is low. In the virgin state the soil is low in nitrogen (N = 0.02 to 0.05 per cent.) and in available phosphate (HCl-extracted P_2O_5 = 0.01 to 0.02 per cent.). Laboratory determinations and field trials have not revealed any other serious deficiencies in major and minor nutrients.

The physical characteristics of the soil lead to considerable mechanical tillage difficulties during the rains. The soil is sticky and plastic and dries slowly except on the surface. Its impermeability creates drainage problems and makes it liable to waterlogging. Cultivation, particularly land levelling, is therefore both difficult and important in ensuring satisfactory crop establishment and growth.

Two economic factors which will govern the pattern of future farming in the area played an important part in determining the choice of crops and farming methods studied at the research station. Because of the distance to potential markets the value of the locally produced commodities had to be sufficient to offset the high transport costs. At present the local demand for agricultural produce is negligible, although in future the established cattle industry may provide a market for some

Table 1
MONTHLY CLIMATIC AVERAGES—KIMBERLEY RESEARCH STATION

Month	Rainfall	No. of Wet Days	Evaporation	Temperature		Humidity 9 a.m.
				Max.	Min.	
	inches		inches	°F.	°F.	%
January	7·21	11	8·74	97·6	75·0	62
February	6·94	10	7·27	95·4	75·1	65
March	4·83	7	8·03	97·2	73·9	55
April	0·86	2	7·81	95·5	69·0	42
May	0·25	*Nil*	7·90	91·8	63·5	33
June	0·22	*Nil*	6·94	87·1	60·8	34
July	0·12	*Nil*	7·33	87·3	58·0	32
August	0·03	*Nil*	8·79	91·0	59·5	30
September	0·10	*Nil*	10·02	96·3	64·8	31
October	0·78	2	11·53	101·5	72·6	37
November	2·72	6	10·02	102·1	76·2	45
December	5·35	10	9·83	99·4	76·2	53
Year	29·44	48	104·96	*95·2	*68·7	*43

* Average.

crops and by-products such as safflower meal. Secondly, in contrast to many tropical areas, labour supply is very limited, seasonal labour completely absent and labour costs are very high. Consequently farming must be highly mechanised and labour requirements must be distributed as evenly as possible.

II.—RICE

It was recognised early in the investigation of farming potentialities of the lower Ord valley that climate, soil and the prospect of plentiful irrigation water favoured rice production. Consequently rice has been given major attention in the research programme of the station. In recent years the yields recorded at the station have been between 3,000 and 4,000 lb. of paddy per acre. Considerably higher yields (up to nearly 7,000 lb. per acre) have been recorded in some experimental treatments. Although there is still much to be learned about rice culture under Kimberley conditions, with existing knowledge and good husbandry yields of 1½ tons per acre should be obtainable on a farm scale. Rice has been recommended as one of the main crops for the pilot farming project being established.

Initial trials indicated that rice could be grown as both a wet and dry season crop, and that, in general, *indica* varieties are better adapted to wet season and *japonica*

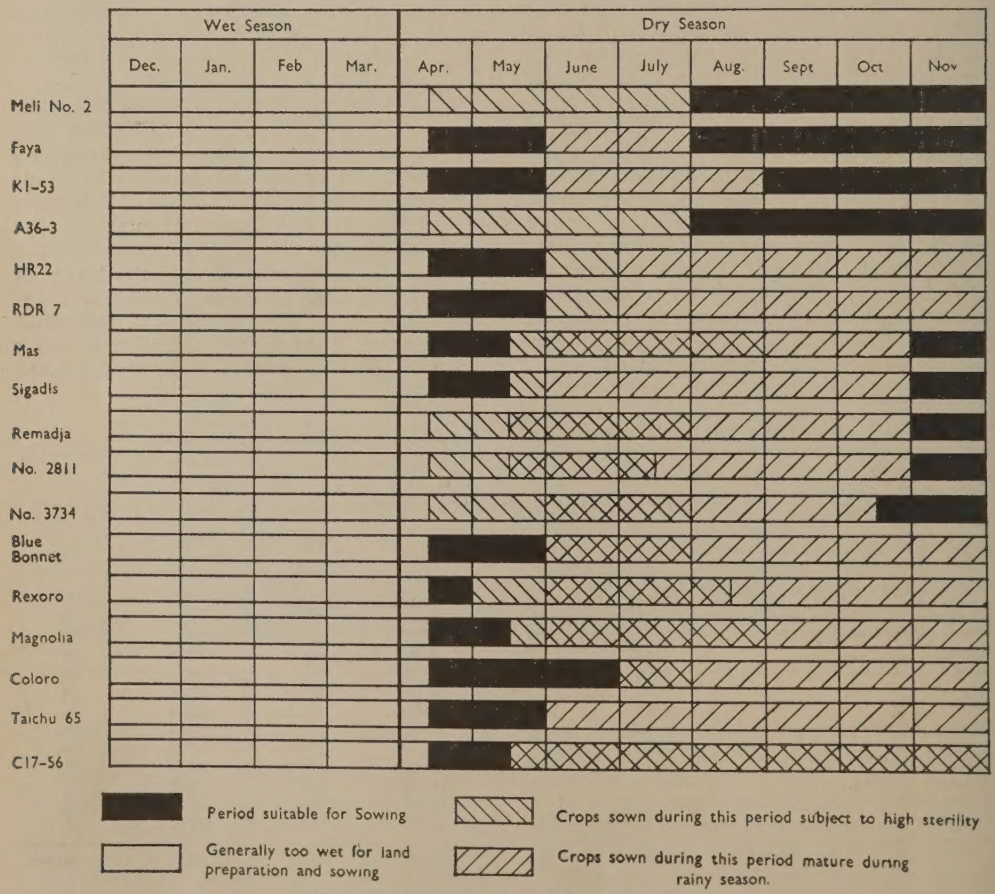


Fig. 2—Suitable planting dates for 17 varieties of rice

varieties to dry season conditions. A more detailed study carried out recently (Langfield and Basinski in press) has confirmed the existence of large intervarietal differences in response to time of planting. In several varieties a fortnight's difference had a considerable effect on growth, tiller numbers and spikelet sterility. The results summarised in Figure 1 indicate suitable planting dates for the 17 varieties tried.

Over 400 varieties were subjected to preliminary adaptation tests. On the basis of subsequent variety trials, *indica* Meli No. 2 and *japonica* Caloro were provisionally chosen as standard varieties for agronomic work in the wet and dry seasons respectively. Meli No. 2 was selected from a number of *indica* varieties with similar grain yields because of its somewhat superior straw strength.

In fertiliser trials, significant yield responses to superphosphate have been recorded with applications of up to 2 cwt./acre, even on previously-manured land. Considerable attention has been given at the station to nitrogen nutrition. In experiments described by Langfield and Chapman (1959) grain yield response of wet season grown *indica* varieties was non-significant above the 40 lb. N/acre level. In contrast *japonica* varieties gave significant yield responses up to 120 lb. N/acre. With *indica* varieties high rates of nitrogen application increased vegetative growth considerably and led to severe lodging while the vegetative response of *japonica* varieties was less marked.

Split application of nitrogenous fertiliser (Langfield 1959a), with part given at seeding and part about a month prior to ear emergence, increased the yields of slow-maturing *indica* varieties but tended to reduce yields of *japonica* varieties.

It has been shown ((Langfield 1959b) that 3 in. deep placement of ammonium sulphate applied at seeding increases yields of Meli No. 2 and Caloro (Table 2). Current trials indicate that the same is true of urea, and that greater depth of placement has no advantage.

Results of a study of the effects of delayed harvesting on grain moisture content and percentage of broken grain (Langfield 1957) show the importance of timely harvesting in determining the quality of rice grown under local conditions (Table 3).

Table 2

EFFECT OF DEEP PLACEMENT OF AMMONIUM SULPHATE ON YIELDS OF RICE AT KIMBERLEY RESEARCH STATION

Ammonium Sulphate		Yield in lb./acre	
Depth of Placement	Time of Application	Wet Season Meli No. 2	Dry Season Caloro
3 in.	At seeding	5,350	6,922
1 in.	At seeding	4,407	5,440
Surface	At seeding	4,356	5,370
Surface	Early tillering	4,110	4,257
L.S.D. at P = 0·05		306	633

Table 3

EFFECT OF DATE OF HARVEST ON SUN-CRACKING OF RICE GRAIN

Days from Flowering	Moisture Percentage at Harvest		Whole Grain Percentage on Shelling	
	Shive Pu	Hnan-wa-phin-gauh	Shive Pu	Hnan-wa-phin-gauh
28	20·8	26·2	99·0	99·4
29	19·9	25·5	97·2	96·1
30	18·2	25·6	83·1	93·3
31	17·2	22·3	83·9	91·2
32	17·8	23·1	84·2	92·8
33	16·6	21·8	83·7	89·8
35	16·2	16·7	82·0	89·0
37	16·0	15·5	81·1	77·6
39	11·8	13·0	78·2	61·9
42	11·6	11·5	52·0	41·0
45	11·1	11·3	41·0	40·0
58	11·1	....	40·3	....

Cutting of variety Shive Pu commenced 7th May, 1956, and Hnan-wa-phin-gauh on 14th May, 1956.

For several years stem-borer damage has been serious in wet season rice crops. The main species responsible has been identified as *Tryporyza innotata* Walker. During the last few years damage has been negligible. It is still uncertain whether this is due to recently-introduced control measures (frequent dusting with Endrin and early dry season ploughing of rice bays to allow soil infested with overwintering prep-pupae to dry thoroughly) or whether other factors have been responsible for the general reduction in the stem-borer population.

III.—SAFFLOWER

The second crop recommended for the pilot farming project is safflower. Yields during recent years have been between 2,000 and 3,000 lb./acre and no major difficulties have been encountered in growing the crop (Beech 1960). The oil content of the variety provisionally selected for agronomic work is of the order of 30 to 35 per cent. If the oil were to be extracted locally safflower meal would prove useful to the existing cattle industry.

Safflower growing at the Kimberley Research Station

Successful growing of safflower is confined to the cool dry season. To obtain high yields the crop must be planted as soon after the rains as possible. Planting is generally inpracticable until early May but there is an appreciable yield reduction if planting is delayed beyond early June (Table 4). The decline in yield is associated with diminished vegetative growth, fewer branches and flowering heads, lighter grain with lower oil content and an increased proportion of unfilled grain.

It is evident from the work of the station that dense safflower stands are essential not only for high yields but also to avoid prolonged flowering and uneven maturation. In a rate of seeding experiment significant yield responses were obtained with an increasing seed rate up to 80 lb./acre. Such high rates are probably essential at present because establishment counts indicate high pre-emergence and post-emergence seedling mortality. The factors causing this are under investigation. Although no significant yield differences were recorded as a result of row spacing treatments ranging from 7 in to 21 in., close row spacing is favoured, particularly on weed infested fields.

Rather variable results were obtained in safflower fertiliser trials. They showed that, particularly on virgin land, superphosphate application is necessary. Application of nitrogenous fertilisers alone, failed to produce a significant yield response, although in one trial increased yields were obtained where nitrogen and phosphate were applied in combination.

Without effective control measures the damage caused by insect pests can be serious. For example, in 1959, an untreated plot yielded 600 lb./acre less than a crop regularly sprayed with Endrin and DDT

Table 4

EFFECT OF DATE OF PLANTING OF SAFFLOWER ON YIELDS, OIL CONTENT AND IODINE VALUE

Date of Planting		1956			1957		
1956	1957	Yield	Oil	Iodine Value	Yield	Oil	Iodine Value
		lb./acre	%		lb./acre	%	
3 May	2 May	2,179	31·7	150	1,974	28·3	146
17 May	16 May	2,214	31·6	148	1,983	28·5	145
31 May	30 May	1,980	28·5	146	1,435	29·7	144
14 June	13 June	2,011	28·9	149	1,105	30·1	142
28 June	27 May	1,701	29·0	149	897	29·8	141
12 July	11 July	1,061	29·6	144	812	28·0	139
26 July	25 July	680	28·7	144	734	27·1	140
9 August	9 August	412	27·4	144	250	20·2	137
....	23 August	....	....	....	52	13·0	....
L.S.D. at P = 0·05		152	....	....	260	1·7	....

mixture. The main pests are foliage eating larvae of *Prodenia litura* and *Heliothis armigera,* which damage fruiting points.

IV.—COTTON

Until 1955, when a satisfactory technique of insect control was evolved, insect damage hampered cotton research by seriously reducing yields and obscuring treatment effects. During the last few years, however, experimental cotton yields of over 2,000 lb. seed cotton/acre have been common, and yields approaching 3,000 lb./acre have been recorded in some trials. Lint quality has been generally satisfactory. Provided processing and marketing problems can be overcome cotton should become one of the main commercial crops of the area.

Cotton in boll at Kimberley Research Station

A large range of varieties, belonging to all main races of cultivated cottons, has been included in preliminary adaptation trials. At present, because of the type of lint required by Australian spinners, cotton varietal work is mainly concerned with *hirsutum* varieties, although long staple *barbadense* varieties grow well. D&PL is currently used for agronomic experiments, but it is felt that further improvement in yield, and quality can be achieved by selection and breeding for local conditions.

Time of planting is one of the main problems of cotton growing under local conditions of soil and climate. The physical nature of the soil is such that for dependable machinery operation cotton has to be planted by early December before the heavy rains. With this date of planting, bolls of the varieties so far available begin to open before the end of the wet season and are exposed to rain damage. When grown as an irrigated dry season crop the growth and development of cotton is affected by cool mid-winter temperatures and maturity is delayed until the following early rains. The solution to the problem is sought through the development of land preparation and planting techniques which would permit cotton to be planted during the dry spells after early December and through selection and, if necessary, breeding of late-maturing varieties.

Another problem, which has by now been largely overcome by a general improvement in farming technique, is that of establishment. Unless careful levelling ensures uniform drainage, cotton planted on the flat is liable to suffer from waterlogging, resulting in uneven patchy stands. Establishment on ridges is under investigation and there are indications that the method may prove successful.

Cotton, like other crops grown at the station, responds to phosphate applications. No significant responses to nitrogen fertiliser have been recorded, though this conclusion is not regarded as final and further nitrogen nutrition studies are in progress.

Prior to 1955 insect damage was severe. Boll damaging insects were the main cause of depressed yields, since in many cases the early damage to foliage, stems and terminals was largely compensated for by subsequent growth. At present control is achieved through frequent spraying with a mixture of Endrin and DDT. Further pesticide research and study of insect pest ecology is under way to reduce the costs of plant protection.

Angular leaf spot is common at Kimberley and on occasion develops into the more severe blackarm stage (Thomson and Basinski 1959). In general, *hirsutum* varieties are less affected than *barbadense,* although Sudan-bred BAR varieties of the latter species have also proved blackarm resistant (Thomson and Basinski 1960). The recovery from blackarm of *hirsutum* varieties after the advent of dry and cooler weather has been remarkably good.

V.—SUGAR CANE

In spite of very promising results from earlier research, work on sugar cane has

been recently suspended because of lack of market prospects.

The yields obtained (Anon 1958) compare favourably with those in areas where cane growing is well established in Queensland. In all trials carried out between 1951 and 1956 the mean yield of all treatments, varieties and harvests (including third ratoons) was 30.8 tons of cane per acre with average CCS of 13.84, giving an estimated mean sugar yield of 4.25 tons per acre. The corresponding figures for the best varieties were:—

Variety	Cane (tons/acre)	CCS.	Sugar (tons/acre)
Pindar	39·9	13·00	5·0
POJ 2878	36·3	14·71	5·9
Q 28	30·6	15·05	5·0

A number of varieties tried are of value in the local environment. Some, like Pindar, grow well whether planted early or late, others like POJ 2878 ratoon well, while yet others have a high sugar content. Undoubtedly still further improvement could be achieved by introduction of new varieties.

Standard methods of land preparation, planting and subsequent cultivation have been found satisfactory under local conditions. With the majority of varieties planting early in the dry season leads to better yields of plant crop although the yield differences tend to disappear in ratoon crops. Highly significant yield responses were obtained from annual applications of phosphatic and nitrogenous fertilisers, the response of nitrogen increasing in ratoon crops.

The sugar content of cane grown under Kimberley conditions reaches a peak between July and October according to variety and age of the crop so that harvest could be spread over three to four months to allow efficient operation of a mill. The yields obtained indicate that in general a third ratoon would not be profitable.

The cane grown at the station has been remarkably free from serious diseases and pests.

Enough work has been done to show that, given the right economic conditions, cane could play a major part in the agricultural development of the area.

VI.—OTHER CROPS

Apart from safflower, linseed appears to be at present the most promising dry season oil crop. The clay soil is ill-suited to the preparation of the fine seed-bed required for linseed, but during the last few years, satisfactory establishment has been achieved through improved land preparation technique, shallow seeding and

Linseed ready for harvest. Safflower in the background

introduction of bigger seeded varieties. Time of planting proved important in linseed growing, as illustrated by the results of a recent trial given in Figure 2 (Beech, unpublished data.)

In early trials, peanuts grown as a wet season crop gave promising yields, some treatments exceeding 3,000 lb./ac. However, they present a problem both in harvesting on heavy clay soil and in separating nuts from soil lumps of similar size.

Sunflower has been tried as both a dry and wet season crop, but because of high post-emergence mortality and imperfectly filled seed heads the yields have been disappointing. Soya bean grows reasonably

Castor beans still in the early stage of trial

well during the wet season, but all varieties tried up to date mature unevenly and shatter badly, making mechanical harvesting impracticable. Preliminary trials carried out recently with castor and sesame indicate that the former justifies further attention as a dry season crop.

Experiments with sorghum demonstrated that it can be grown successfully as a wet season crop, providing it escapes bird damage, a factor which has ruined many trials. The highest yield recorded was 5,000 lb./acre, although the general yield level was less than 1 ton/acre. Trials with millets and maize were also seriously affected by pests; locusts and birds were the most important. Wheat grown in preliminary dry season trials yielded up to 2,000 lb./ac. Yields of oats and barley have been disappointing. Early trials also

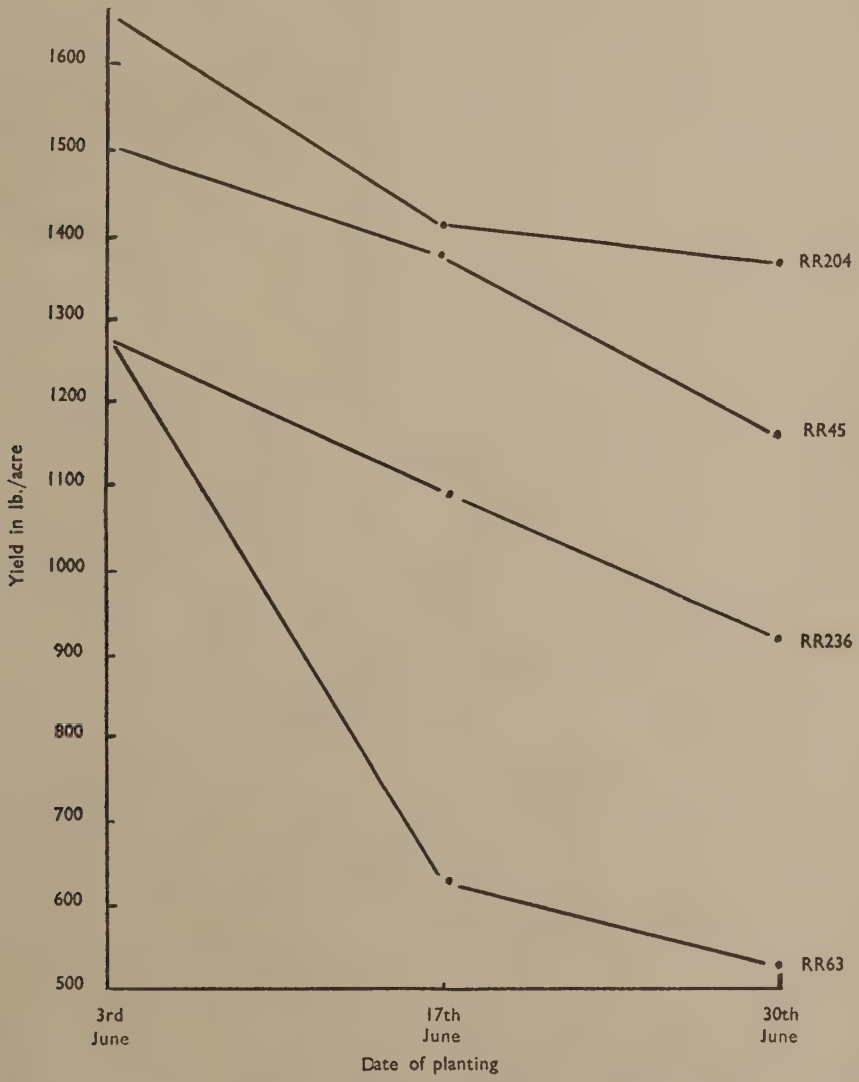


Fig. 2—Effect of time of planting on the yield of 4 linseed varieties

included jute, kenaf, and roselle hemp. The mean yield of jute over a three year period was 10½ tons/acre, with 5 per cent. fibre content. Kenaf yields were higher than jute, but fibre was of inferior quality.

The results of trials with a wide range of fodder and pulse legumes (cowpeas, pigeon peas, grams, guar, etc.), were disappointing. Dry season growth was generally poor, while in the wet season legumes proved particularly susceptible to sporadic flooding and waterlogging, difficult to avoid under local conditions. With the exception of *Clitoria ternata,* the legumes so far tried have proved susceptible in varying degrees to the virus disease "witches' broom" which is common amongst the native plants of the region.

In the early years of the Station considerable effort was made to find suitable irrigated pasture species and fodder crops for the local cattle industry. Without exception all introduced legumes and grasses made the maximum growth in the wet season when productivity of native pastures is high and when grazing on irrigated clay soil presents considerable difficulties. Fodder conservation is also difficult during the rains. If left uncut or ungrazed until the early dry season pastures and fodders lose their feeding value. It is thought at present that protein-rich concentrates, the by-products of oil crops and cotton, may provide at least a partial solution to the problem of dry season deterioration in quality of the native pastures, although further search for suitable pasture and fodder species is justified.

VII.—CONCLUSIONS AND FUTURE WORK

The difficulties encountered in the work of the Station over the last 15 years are common in initial research in many undeveloped areas without previous agricultural experience and an established farming industry. In these circumstances the research worker is left alone to determine environmental potentialities and limitations, define research problems and to assess their relative importance.

Early work at the Station was handicapped largely by the lack of practical experience in farming difficult clay soils under the local environmental conditions, an art rather than a science. Moreover, until suitable crops and varieties were found and their proper growing periods determined, little progress could be made in agronomic work, while lack of agronomic knowledge (nutritional requirements, method of sowing, spacing, irrigation requirements, etc.), affected the search for right crops and varieties. Damage by pests, particularly insects, also hindered the work until satisfactory protection measures were developed. Early progress was therefore inevitably slow.

The work of the past 15 years has laid the basis for the development of commercial farming in the area, but many problems require further investigation and development will undoubtedly reveal many new ones. Further entomological work is needed to reduce the cost of pest control. Weed infestation has been increasing over the last few years and a special study of weed ecology and methods of weed control has been recently initiated. Although irrigation requirements were determined approximately in the early work, a more basic study of plant-water relationships is commencing, to provide the foundation for the proper planning of the irrigation and drainage regime necessary to ensure maximum yields. Further nutritional investigations, particularly on soil and plant nitrogen problems are also in progress. The search for new cultivars is also continuing.

Studies will shortly start on the best use for protein supplements which may be available to the local beef cattle industry when oil crops and cotton are grown. Since the development of irrigation farming may provide a stimulus for the parallel development of dryland agriculture on adjacent lighter soils, a study of the potential and problems of these soils has recently begun.

The knowledge gained at the Station is most directly useful in farming the areas adjoining it. However it has also wider application in other localities in Northern Australia where climate, soil and water resources are similar to those found in the Ord Valley.

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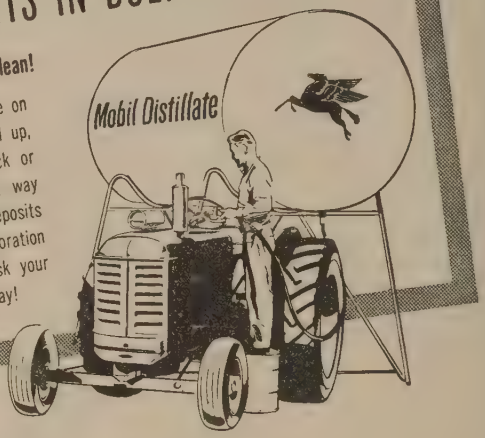

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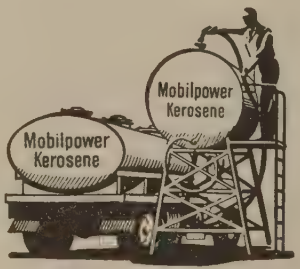

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Rice Stem Borers

AT THE

Kimberley Research Station

By L. E. KOCH, M.Sc., ENTOMOLOGIST

STEM boring caterpillars have severely damaged rice crops at the Kimberley Research Station, near Wyndham, and studies have been made on the biology, abundance, and control of these insects.

About 15 acres of experimental rice have been grown at the Kimberley Research Station each year since 1947. Rice stem borers have been present in varying numbers and have caused from mild to severe damage. During severe infestations practically no yields have been obtained from some of the plots.

Fig. 1.—General view of rice crop

In the rice growing procedure adopted at the station, the rice bays are gradually flooded, after the plants are about 5 inches high (and the water level is slowly raised until a depth of about 6 inches is reached. This level is then maintained until after flowering time. For further details about rice cultivation at the station see Anon (1958a and 1958b.)

Tropical indica varieties of rice, which are grown during the wet summer season, November to April, are damaged, but the relatively little rice grown during the dry season is untouched.

The caterpillars cause the damage by boring in the stems of the plants and eating through the nodes. The damaged plants develop abnormal panicles, which are empty and white in advanced cases, and are popularly known as "whiteheads."

Two species of moths, *Tryporyza innotata* (Walker) and *Niphadoses palleucus* Common, are involved. They were identified by Mr. I. F. B. Common (Principal Research Officer, C.S.I.R.O., Canberra), who recently described them (Common 1960).

DESCRIPTION

The two species of moths can be distinguished in the field by a few small differences. However, the insects are superficially much alike in all stages of the life cycle, and the general account below applies to them both.

The moths, which measure about an inch across the expanded wings, are snow-white in colour except for the eyes which are black.

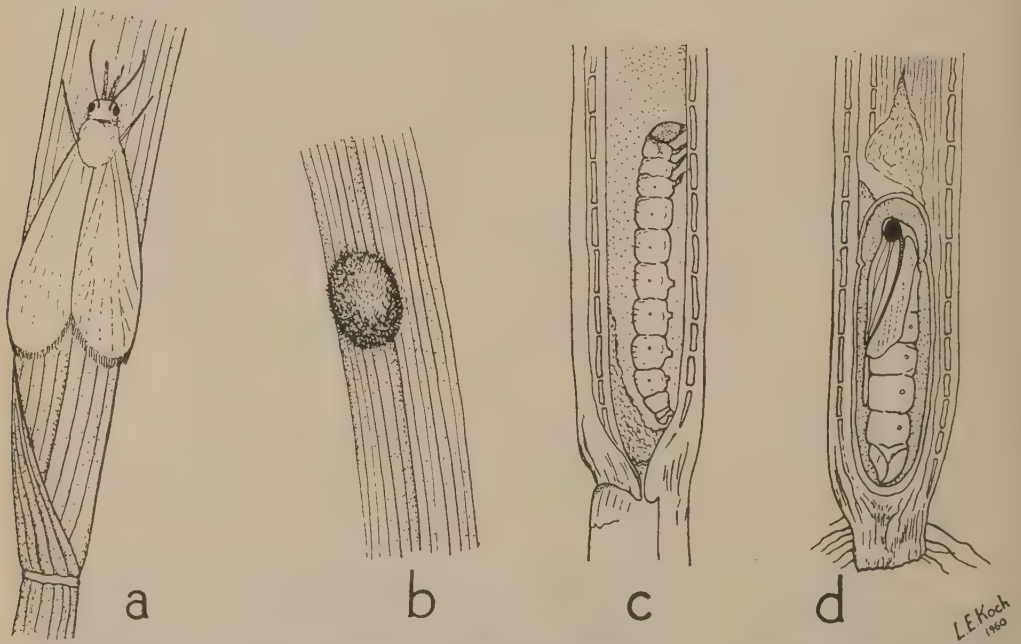

Fig. 2.—a, Moth on rice plant; b, Eggcluster on leaf. c, Caterpillar feeding within stem. d, Pupa within cocoon in basal internode

The eggs are laid in clusters covered with hairs and scales from the female moth.

The caterpillars measure somewhat less than an inch in length when fully grown, and are white with yellow heads.

The pupae are yellowish white at first, become silvery white before the adults emerge, and are found in white cocoons within the rice stems.

LIFE HISTORY

The insects are usually first detected each season following the occurrence of isolated patches of dead leaves among the

young plants. These patches are evident from as early as a fortnight after the germination of the crop and result from the feeding activities of the young caterpillars.

The caterpillars enter the plant by making a hole in the side of the stem and it is not uncommon to find more than one caterpillar in each infested stem. Plants that have rotted are abandoned by the caterpillars which then invade suitable adjoining stems. Each insect may thus damage several plants during its growing period.

When fully grown, the caterpillar spins the cocoon and pupates within it, usually in the basal internode. The adult moth emerges from the pupal case and leaves the plant through a hole, previously made by the caterpillar, near the top of the cocoon. The moths are usually encountered resting upright on the leaves.

Four generations of these moths were observed in the 1956-57 season. The insects of all generations follow the general life history described above except that the caterpillars from the last generation of moths in the season burrow about an inch into the soil and remain there as prepupae over the dry winter months until the beginning of the next rice-growing season. They then pupate and the moths emerge.

LIGHT TRAP CATCHES

A light trap has been set at night and a daily count made of the catches of rice stem borer moths. During January, February and March in 1957, the year in which the insects were most abundant, over 38,000 of these moths were caught; and for most of this period, *T. innotata* comprised about 80 per cent. of the stem borer catch.

CONTROL

The insecticides, DDT and BHC, were applied as dusts previous to 1957. These dustings though effective in killing many moths, did not serve to prevent further infestation.

During the last few years, endrin dust has been repeatedly used at the rate of 2 oz. active ingredient per acre. The moth population has decreased during this period but other factors, such as climate

Fig. 3.—The light trap and its location

or biological control, may also have been responsible for this reduction in moth numbers.

A species of small wasp is known to parasitise the rice stem borer eggs and another wasp species is suspected of parasitising the pupae. Both these wasps occur in large numbers and they may at times play an important part in regulating the abundance of the rice stem borers.

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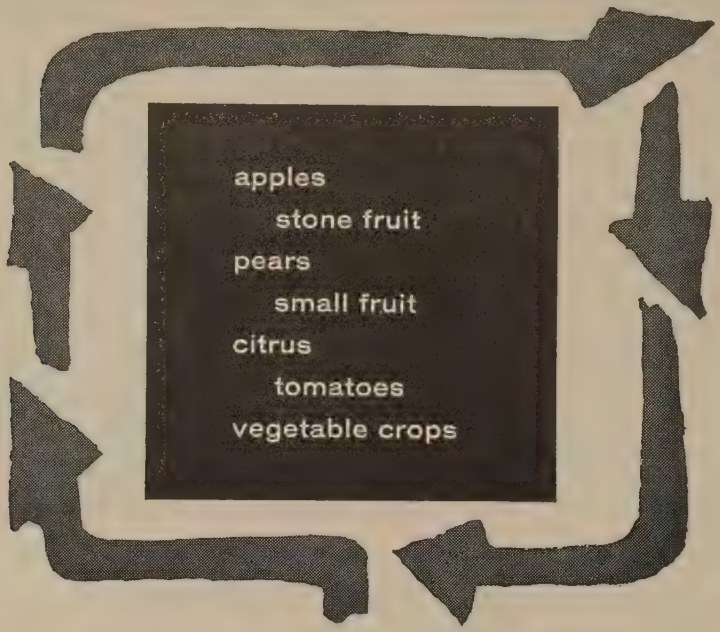
CORRECTION

On page 819 of the "Journal of Agriculture," Vol. 1 (Fourth Series) No. 9, September 1960, "List of Registered Stock Foods and Stock Licks, 1959-60," for "1959-60" read "1960-61."



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Beef Growth Rate Studies . . .

Wokalup Research Station

— *Project 6*

Comparison of Growth Rates on Irrigated and Unirrigated Pastures of Two Year Old and Yearling Beef Dairy Crosses and of Yearling Jersey Steers.

By M. CULLITY, B.Sc. (Agric.), Superintendent of Dairying

PERIOD

February 7 to May 2, 1957.

STOCK

Steers bred on the research station were used. They included Hereford crosses from dairy cows, and Jersey steers.

Groups 1 and 2 each contained 17 Hereford dairy steers, born in the autumn of 1955.

Groups 3 and 4 contained respectively 25 and 26 Hereford dairy steers all born in the autumn of 1956.

Groups 5 and 6 had 13 and 12 Jersey steers respectively all born in the autumn of 1956.

Groups 1 and 2 had been weighed as from May 31, 1956, while Groups 3, 4, 5 and 6 were weighed first on January 21, 1957.

Some of the beef crosses and all of the Jerseys were got by artificial insemination.

PROCEDURE

Groups 1, 3 and 5 were grazed together on irrigated pastures and Groups 2, 4 and 6 were grazed together on dry pasture.

Yarding and weighing of the cattle were as described in the previous reports upon work at this station.

PASTURE

The general type of pasturage was as described in the previous report. Cattle in the groups on irrigated pastures were

Table 1

PROGRESSIVE WEIGHTS

Date of Weighing	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
	Dry Pasture 17 H x Steers born 1955	Irrigated Pasture 17 H x Steers born 1955	Dry Pasture 25 H x Steers born 1956	Irrigated Pasture 26 H x Steers born 1956	Dry Pasture 13 Jersey Steers born 1956	Irrigated Pasture 12 Jersey Steers born 1956
	lb.	lb.	lb.	lb.	lb.	lb.
13/12/56	1,069	1,054	....	....	....	....
21/1/57	....	....	552	533	354	320
7/2/57	1,076	1,128	588	575	383	353
7/3/57	1,076	1,193	598	644	411	430
4/4/57	1,028	1,201	582	664	396	456
2/5/57	1,011	1,227	578	707	400	514

WOKALUP RESEARCH STATION

BEEF PROJECT

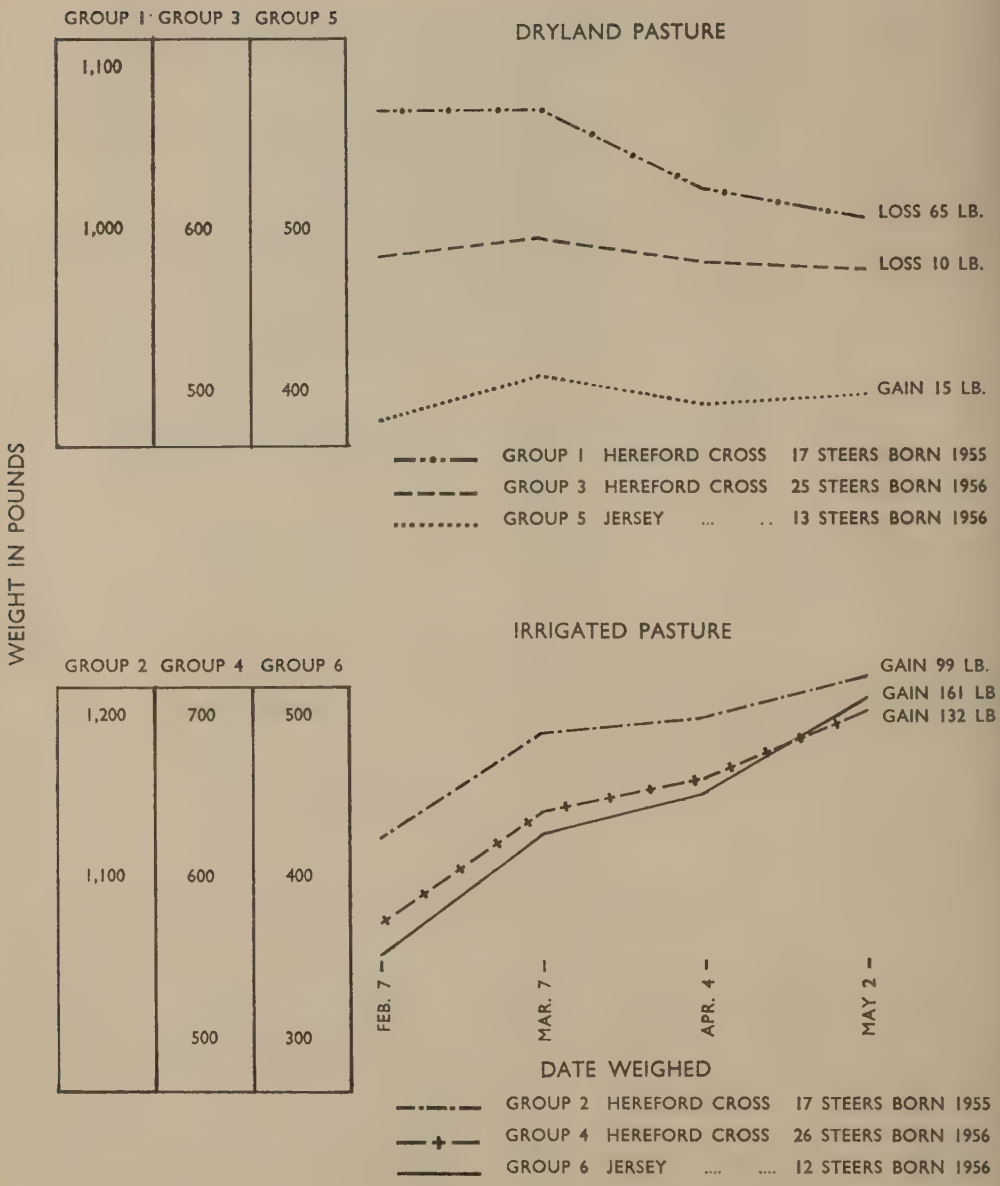

Fig. 1

1066

Some of the foundation cows with Hereford-sired progeny at Wokalup Research Station

removed only for short periods to enable watering to be carried out. Those on dry pasture throughout the trial were on relatively innutritious grass with dry sub clover.

COMMENTS

By the Manager, Mr. K. W. Simes, and Technician, R. G. Elliott under dates of various weighings are as follows:—

January 10—

Rainfall December 13 to January 10—9 points.

Unirrigated groups—good dry feed, clover and grass.

Cattle are not as loose as those on irrigation.

Irrigated pastures excellent, comprising paspalum, ryegrass, and white clover—cattle inclined to be loose.

February 7—

Rainfall January 10 to February 7—14 points.

Unirrigated groups grazing on hill paddocks.

Groups 3 and 5 have increased in weight while Group 1 has lost weight.

Irrigated groups—increase in weight is consistent.

Group 2, 1955, drop look particularly well.

March 7—

Rainfall February 7 to March 7—9 points.

The unirrigated pasture groups are now slowing up. The 1956 drop animals have increased in weight but are a complete contrast in appearance to their parallel groups on irrigation. The dry pasture seems sufficient for maintenance only.

The irrigation groups have made excellent progress and all look very well.

April 4—

Rainfall March 7 to April 4—79 points.

The unirrigated pasture groups all show decreases—the loss in Group 1 being particularly heavy. Dry feed is not sufficient in quantity and quality. Stock are healthy.

The irrigated pasture groups are still making progress but not so rapidly as previously. The younger animals look well.

May 2—

Rainfall April 4 to May 2—247 points.

The unirrigated pasture groups are not doing well and are falling further behind the comparable group on irrigation. Rain has fallen and annual winter pastures are germinating. The young animals are showing a natural growth increase but are only in fair condition—all are healthy.

The irrigated pasture groups are still growing but pasture obviously has not been as good as in the previous month—watering has ceased but good rain has fallen and temperatures are mild. Group 2 are now well over 1,200 lb.; excellent growth for two-year-olds. The younger groups look very well and have gained 200 lb. per head since weaning in January.

RESULTS

The results of this trial are summarised in the Tables 1 and 2. Growth curves for each group are shown in Figure 1 which

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gives a comparison for irrigated and unirrigated pasture and in Figure 2 where the curves are arranged to permit a direct comparison of growth for the various stock classes in the two sections irrigated and unirrigated.

DISCUSSION

This trial has enabled a comparison to be made between the growth rate of the three different types of cattle, i.e., two-year-old Hereford cross, yearling Hereford cross and Jersey steers on irrigated and on unirrigated pasture.

For the purpose of the main comparison, the period February 7 to May 2 is used. Data however, is presented in the tables for weighing of Groups 1 and 2 from December 13, 1956, and for Groups 3, 4, 5, and 6 from January 21.

A February weighing as a base was adopted as previous projects have shown that steers on dry pasture usually continue to gain weight up to the January weighing.

VALUE OF IRRIGATION

In each of the cattle sections, i.e., the two-year-old beef crosses, the yearling beef crosses, and the Jersey steers, the growth rates on irrigated pasture was much superior to that on unirrigated pastures. The difference in the two-year-old animals was 164 lb., those on irrigated

Table 2
SUMMARY OF WEIGHT GAIN

Date of Weighing	Group 1 Dry Pasture 17 H x Steers born 1955	Group 2 Irrigated Pasture 17 H x Steers born 1955	Group 3 Dry Pasture 25 H x Steers born 1956	Group 4 Irrigated Pasture 26 H x Steers born 1956	Group 5 Dry Pasture 13 Jersey Steers born 1956	Group 6 Irrigated Pasture 12 Jersey Steers born 1956
	lb.	lb.	lb.	lb.	lb.	lb.
Feb. 7–May 2	—65	99	—10	132	17	161
Per day	— 0·77	1·18	— 0·12	1·57	0·20	1·92
Dec. 13–May 2	—56	176	....	....	....	....
Per day	— 0·41	1·23	....	....	....	....
Jan. 21–May 2	....	....	26	174	46	194
Per day	....	....	0·25	1·72	0·45	1·92

Table 3
DIFFERENCES IN GROWTH

Groups (I.—Irrigated Pasture) (D.—Dry Pasture)	Period	Days	Difference	
			Per Period	Per Day
			lb.	lb.
Group 2 (I.) Over Group 1 (D.)	Dec. 13–May 2	139	232	1·67
Two-year-old Hereford Cross	Jan. 21–May 2	101	164	1·62
Group 4 (I.) Over Group 3 (D.)	Jan. 21–May 2	101	148	1·47
Yearling Hereford Cross	Feb. 7–May 2	84	142	1·69
Group 6 (I.) Over Group 5 (D.)	Jan. 21–May 2	101	148	1·47
Yearling Jersey	Feb. 7–May 2	84	144	1·71
Hereford Crosses—Yearlings (Grp. 3) over 2-year-olds (Grp. 1) both on Dry pasture	Feb. 7–May 2	84	50	0·6
Hereford Crosses—Yearlings (Grp. 4) over 2-year-olds (Grp. 2) both on Irrigated pasture	Feb. 7–May 2	84	33	0·4
Yearlings—Jerseys (Grp. 6) over Hereford Crosses (Grp. 4) both on Irrigated pasture	Feb. 7–May 2	84	29	0·34
Yearlings—Jerseys (Grp. 5) over Hereford Crosses (Grp. 3) both on Dry pasture	Feb. 7–May 2	84	27	0·32

PROJECT 6

GROWTH TRENDS
IRRIGATED & DRY PASTURE

DECEMBER 12th 1956 TO MAY 2nd 1957

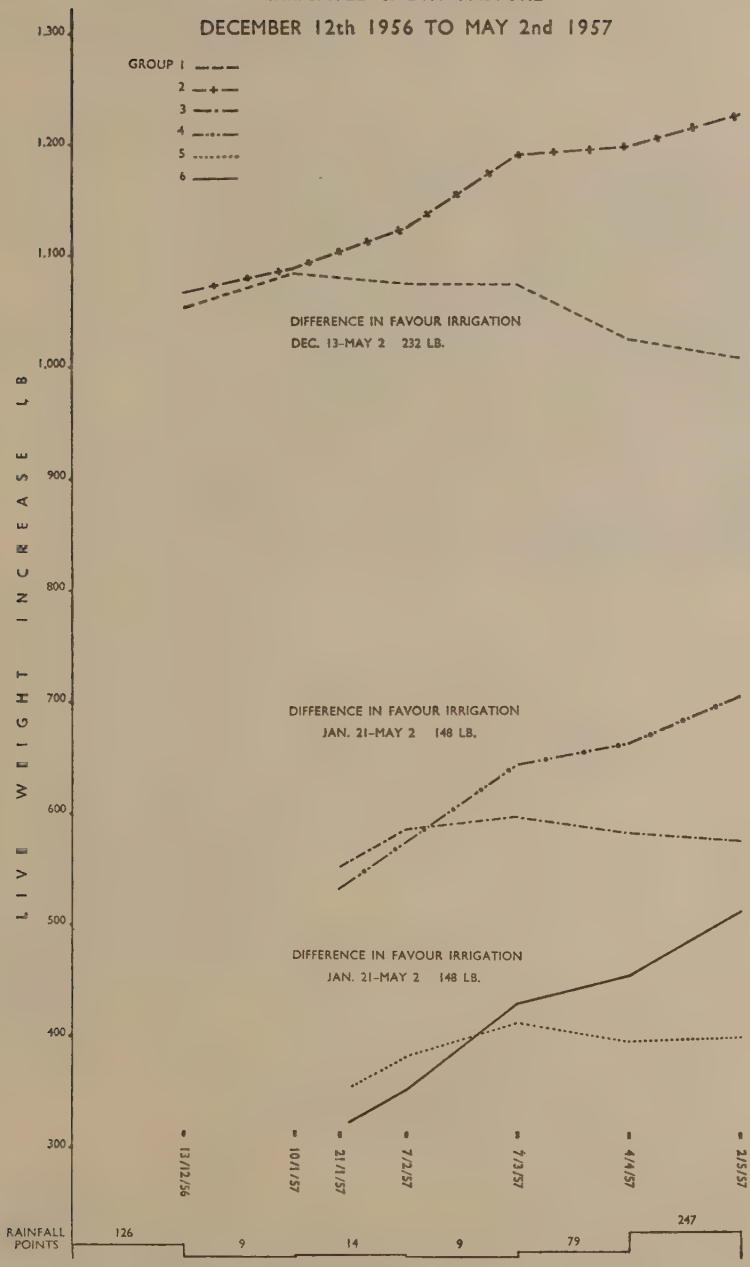

Fig. 2

pastures (Group 2) having gained 99 lb. whilst those on dry pasture (Group 1) lost 65 lb. Group 4 gained 142 lb. more than Group 3. Their actual weight gain was 132 lb. while those on unirrigated pasture lost 10 lb. In the same way the Jersey steers in Group 6 put on 144 lb. more than those in Group 5 which were on unirrigated pasture. The respective growth rates of these two groups was 161 lb. and 17 lb.

This result clearly shows the value of irrigated pasture for fattening cattle during the summer months. Assuming a dressing percentage of 56 per cent. and a value of 2s. per lb. the increased value of the animals in Group 2 above those in Group 1 would be £9 4s. whilst the increased value of Groups 4 and 6 over 3 and 5 was £8 1s. On an average, the irrigated pastures carried two beasts to the acre and therefore the increased value of the pasture could be assessed approximately at £18 8s. for the larger animals and £16 2s. for the smaller. This is a conservative estimate as those animals on irrigated pasture were ready for sale at the conclusion of the trial while those which had been on dry pasture were in store condition only, and their values would be much lower than those assumed above.

Two Year Old Versus Yearling Hereford Steers.

The two groups on irrigated pasture both gained weight but the yearlings grew faster, putting on 33 lb. more than their two-year-old companions, the respective gains being 132 and 99 lb.

On unirrigated pasture both groups lost weight but the yearlings losing 10 lb. only did not fare as badly as the others which declined by 65 lb.

Two-year-old Hereford X dairy breed crosses

Beef Cross Versus Jersey Steers.

On irrigated pasture both groups grew satisfactorily with the Jerseys recording the greatest gain—161 lb. to 132 lb. of the Hereford crosses. The Jerseys were much lighter at the commencement of the period —256 lb.—than the beef cross group—582 lb., the more rapid response being due probably to the lower maintenance requirement of the smaller cattle relative to the quantity of herbage eaten.

On unirrigated pasture the Jersey steers also were recorded to have done better, gaining 17 lb. while the Hereford crosses lost 10 lb., the difference being 27 lb.

Fig. 1 gives a visual comparison of the relative rate of growth of the various groups, while Fig. 2 is designed to show the similarity in trend of growth of the various classes of cattle when on similar feed.

ACKNOWLEDGMENT

Acknowledgment is made of the assistance of Mr. K. W. Simes, Manager, and the members of the staff of the research station.

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EXPLANATION OF PLATE

A—Branchlet with flower buds and fruits; B—Umbel of flower buds (much enlarged); C—Anthers (much enlarged); D—Fruits; E—Section of fruit (enlarged). Spearwood, R. D. Royce 6326

TREES of Western Australia

By C. A. GARDNER

No. 79

Eucalyptus foecunda (Schau).

THIS species is a mallee with an average stature of 5-15 feet, with several erect twiggy branches, the bark smooth except at the very base where unshed patches of a dark greyish-brown adhere to the stems, otherwise it sheds in small plates, leaving a smooth grey-brown bark.

The leaves are erect, green and shining on both surfaces, rather narrow, and terminate in usually long fine points; the leaf-stalks are slender and the leaf-blade gradually narrows into these stalks. The midrib of the leaf alone is prominent, the diverging lateral veins scarcely, or not visible to the naked eye, they diverge from the midrib at a rather wide angle. The whole leaf is copiously oil-dotted, and the average length of the leaf and its stalk is 3-4 inches. The flowers are borne in umbels in the axils of the leaves, the common stalk rarely exceeds half an inch in length. The flowers number 6-10 in the umbel, their individual stalks rarely exceeding one eighth of an inch in length. The hypanthium or calyx-tube is narrow in the bud, but becomes almost pear-shaped at the time of flowering; the operculum or bud-cap is conical, and about the same length as the hypanthium, usually slightly narrowed in the upper half in dried specimens. The numerous filmaments are white in colour, and the small anthers are club-shaped and continuous with the filament, that is they are not swivelled as in most species, and open towards the obtuse summit in small oblique pores. The fruit is pear-shaped, smooth and rounded at the top with a short thick rim, and the remarkable white disc is white and descends obliquely into the fruit orifice; the three fruit valves are at first surmounted by the split base of the style, but these soon break off leaving the persistent portion well included within the fruit itself.

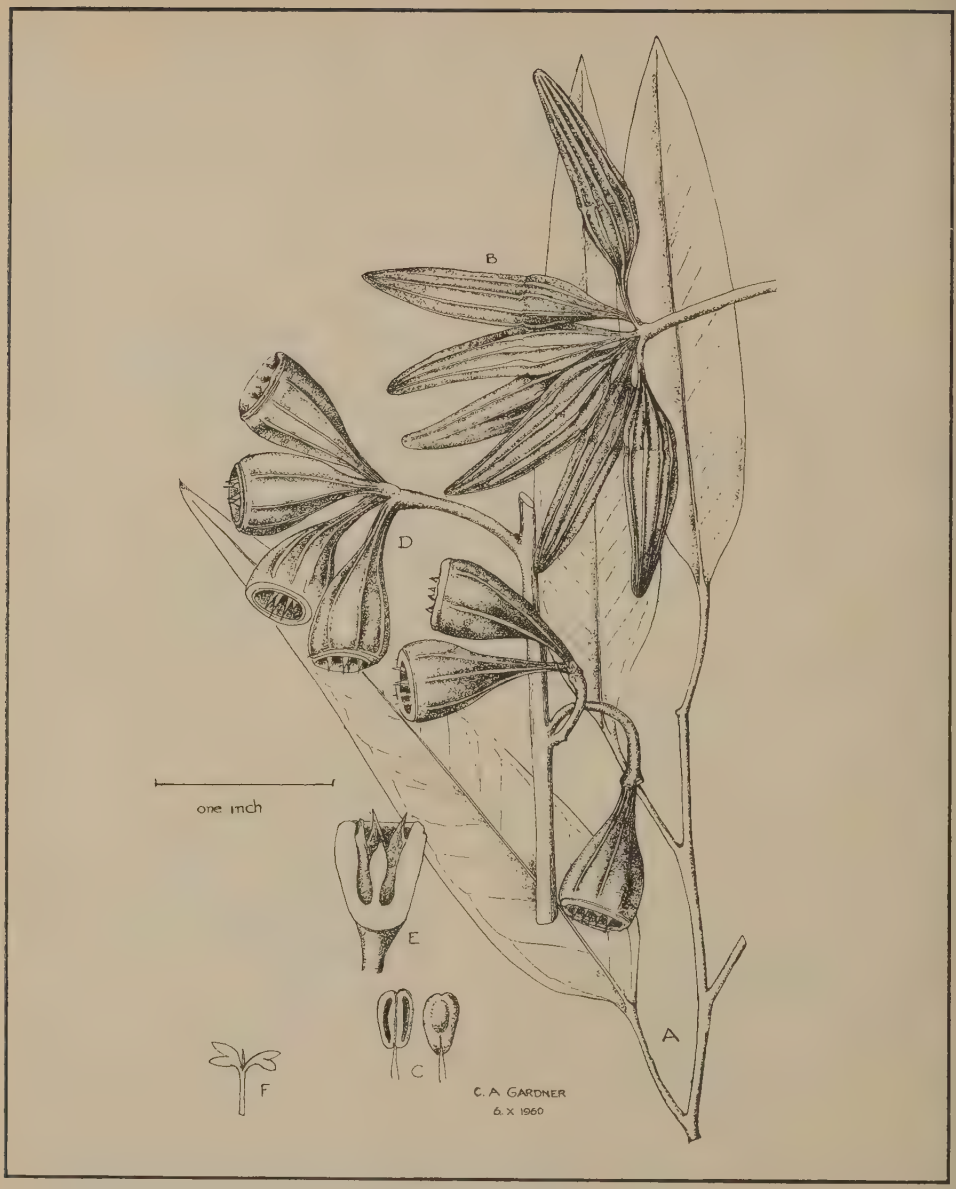
This species was originally collected by Ludwig Preiss on the slopes of limestone hills not far from Fremantle, and it is still to be seen at Spearwood, and towards Sorrento. It was collected without flowers in August 1939. It was subsequently confused by all who have written on Eucalyptus with another distinct species from the coastal districts between the Murchison River and Dongara, as well as Dirk Hartog Island and the Abrolhos, but this latter species has very different anthers. The species is very close to, if not identical with a species named *Eucalyptus leptophylla* by Mueller from South Eastern Australia, and this latter is a common species which varies from a large tree to a small mallee and is widely dispersed in various parts of the interior of Western Australia. The differences between the two are at present under investigation.

No. 80—THE FLUTED HORN MALLEE

(*Eucalyptus Stowardii* Maiden.)

THIS species varies from a tall mallee to a small tree. The bark of the stems is a yellowish-pink or grey in colour, and the outer layers shed in rather thick plates about the month of March, leaving the new bark a yellow or orange colour. A few of the lower plates remain adherent, giving the mallee a rough bark at the base.

The leaves are rather large and highly lustrous, deep green in colour and are up to four and a half inches in length,



EUCALYPTUS STOWARDII Maiden

EXPLANATION OF PLATE

A—Branchlet with leaves; B—Flower buds; C—Anthers; D—Fruits; E—Section of fruit; F—Cotyledons near Mt. Gibson, C. A. Gardner 10203

EUCALYPTUS EREMOPHILA Maiden

EXPLANATION OF PLATE

A—Branchlet with flower buds; B—Anthers; C—Branchlet with fruits; D—Section of fruit; E—Cotyledons. B and D much enlarged. A and B—Between Yerbillon and Bodallin, Gardner sine no. C and D—Between Bullabulling and Coolgardie, Gardner sine no.

normally tapering into a short narrow point. The midrib is prominent, and the easily distinguishable lateral veins diverge from the midrib at a wide angle, the intramarginal vein being at some distance from the leaf-margin. The whole leaf is copiously oil-dotted. The flowers are borne in umbels, in the axils of the leaves, the common stalk curving downwards and usually about an inch in length. The number of flowers in each umbel varies from 5-7, the individual flower stalks (pedicels) being less than the length of the hypanthium which tapers at the base into these stalks, and is itself fluted or ribbed, the number of ribs being usually 10-12, but sometimes some of these are suppressed and the prominent ribs may number only four. The bud-cap (operculum) is at least half as long again as the hypanthium, slightly curved, and prominently fluted or ribbed. The filaments are erect in the bud, pale yellow, angular and sometimes slightly glandular, and the somewhat narrow anthers are attached on the back and open in long slits. The fruiting hypanthium is pear-shaped but truncated at the summit with a cushion-shaped disc which extends downwards internally into the fruit, and the deltoid valves have at first long slender points derived from the split base of the style, but their protruding tips soon break off, leaving the deltoid points slightly protruding from the orifice of the fruit.

The fluted horn mallee has a wide range, extending from Mount Gibson in the north southwards to Tammin and Kellerberrin, and is always associated with soils containing decomposing granite. It is particularly common at Pithara and Wyalkatchem.

No. 81—THE EASTERN GOLDFIELDS HORNED MALLEE

(Eucalyptus eremophila Maiden.)

THIS species is always a mallee. Enjoying a very wide area of distribution which extends from Cleary and Beacon in the north to Pioneer and perhaps Gnowangerup in the south, westwards to Kellerberrin and Dalwallinu, and eastwards at least as far as Kalgoorlie, it exhibits some variation in its structure, especially in the flowers and fruits. The typical form is seen between Merredin and Coolgardie. Southwards from Widgiemooltha the plants are much larger attaining a height of over 20 feet, and these have longer and more flattened common flower stalks and usually longer, narrower and more pointed flower-buds, but intermediate forms occur.

In general the mallee attains an average height of about 15 feet with several stems from a stock-like base, and the bark is a characteristic cinnamon brown in colour, quite smooth except during the late summer months when it sheds the outer bark in rather thick strips. The branches are erect and twiggy. The leaves are neither dull nor glossy, but have a nacreous appearance of an olivaceous grey-green. They are lance-shaped, and commonly about three or four inches in length, tapering at the base into a somewhat flattened leaf-stalk. The flowers like those of the preceding species are drooping on long reflexed foot-stalks which are about an inch in length except in the southern forms where they are longer and distinctly flattened upwards, otherwise they are only slightly flattened. The umbels are 3-7-flowered, each flower being on a thin stalk about the same length as the hypanthium. The hypanthium is somewhat pear-shaped when in bud, but varies from almost globular to shortly cylindrical. The operculum is distinctly narrower at its base than the diameter of the hypanthium, a somewhat distinctive characteristic of this species, and the whole flower-bud is a glossy reddish-brown in colour, shining and quite smooth. The operculum is curved, horn-shaped and about twice as long as the hypanthium. The filaments are erect within the operculum, and vary in colour from an intense crimson to pale yellow, the narrow anthers being attached on the back below the middle and swivelled on the thread-like apex of the filament, opening in parallel longitudinal slits. The fruits are somewhat pear-shaped or shortly cylindrical, on distinct stalks, rounded or truncate at the top with a rather broad flat or rounded disc, and the capsule has short included deltoid valves (see Fig. D.)

Eucalyptus eremophila inhabits loamy soil, frequently found on the margins of the salmon gum forest and forming open thickets. The plant flowers from June to October.

EUCALYPTUS OLDFIELDII F. Muell.

EXPLANATION OF PLATE

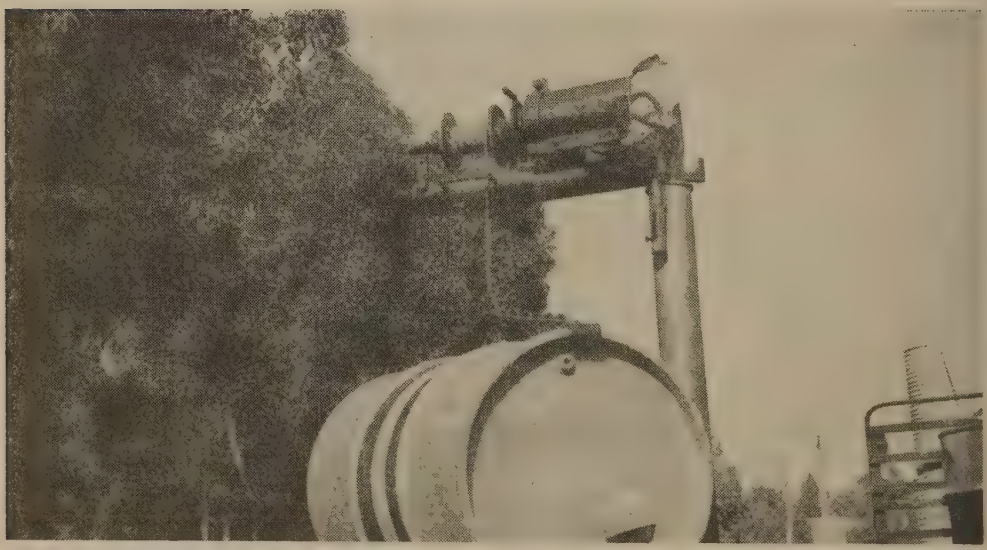
A—Branchlet with leaves and flower buds; B—Anthers; C—Fruits; D—Fruit (enlarged); E—Section of the same. Near Binnu, Gardner sine no.

No. 82—OLDFIELD'S MALLEE

(Eucalyptus Oldfieldii F. Muell.)

THIS species was described by Mueller in 1860 from specimens collected by Augustus Oldfield in the vicinity of the Murchison River where it grows on the sand heaths as a small shrubby mallee. From there it extends through Binnu and Yuna to the Mingenew district, Mount Gibson and perhaps as far south as Cowcowing, as a larger mallee with spreading branches, and up to about 12 feet in height. It is found in a variety of habitats, usually on the open sand heath, in gravelly thickets, and on Mount Gibson a curious form occurs with fluted bud-caps, smaller than the typical form but otherwise the same. The reader is referred to No. 42 of this series where *Eucalyptus Burracoppinensis* is figured and described.

The two species are very close, the essential differences being the smaller, practically stalkless buds and fruits of *Eucalyptus Oldfieldii* together with the prominently exserted valves, and the larger buds and fruits, ribbed and usually distinctly beaked operculum, distinct stalks, buds and fruits and much less exserted valves of *Eucalyptus burracoppinensis.* Otherwise the two species are practically identical, and should not perhaps be kept as separate species.



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APP36

Honey Flora Calendar for January

COMPILED BY R. S. COLEMAN, APICULTURAL SECTION, WITH ASSISTANCE FROM THE BOTANICAL BRANCH

Common Name	Botanical Name	Where Found	Honey		Quality of Pollen	Remarks
			Quality	Quantity		
Karri	*E. diversicolor*, F. Muell.	Donnelly Mill, Pemberton, Shannon Mill area	Choice	Heavy	Poor	Karri flowers in this area over 12 months but the major flow is mid-December, to the end of April. Flowering cycles are apparently tied up with maturing fruit on trees, winter rains to induce growth, and temperate weather in summer when the very small buds are present. Buds from growth of young tips to flower—three years.
Wandoo or White Gum	*E. redunca* var. *elata*, Benth.	Early Summer Wandoo flowers on the flats in the Dale area	Good 1st Class	Heavy	Poor	Good winter rains are necessary for set of buds, therefore flowering reflects rains of three winters before. Buds from growth of young tips to flower—three years.
Powder Bark Wandoo	*E. accedens*, W. V. Fitzg.	Occurs on the eastern side of main heavy rainfall Wandoo belt. Occurs on the ironstone ridges	Good 1st Class	Heavy medium	Excellent	Powder bark can be differentiated from Wandoo by the powdery bark and from the fact in early winter the bark has a salmon colour. Starts to flower at the end of January, and invariably sheds some mature buds just before flowering; this does not seem to lessen the crop of honey. Buds are held for three years, much the same as Wandoo.
Sugar Gum	*E. cladocalyx*, F. Muell.	Not a native of W.A. but used as a street tree	Good	Heavy	Good	As this tree is planted extensively in some towns, the local beekeepers get a good crop. Buds believed to be one year old at flowering.
Morrel	*E. obosa* var. *longicornis*, F. Muell.	Wheat belt area	Good	Unknown, but a few reports have said good	Good	A tall tree on good soil, widely scattered and difficult to find enough trees to work as a flow, could be tried when nothing else available. No information on buds.
Gimlet	*E. salubris*, F. Muell.	Outer wheat belt, to pastoral country	Not known	Useful	Good	Will not stand adverse conditions at flowering, as it will drop its buds. Main flowering in February.
Yellow Tingle	*E. Guilfoylei*, Maiden	Lower S.W. rain-forest usually in valleys and low ground	Good flavour poor honey	Good	Unknown	An unreliable producer, good rainfall years followed by good flows, flow is cut off by cold weather. Starts in November and finishes in January. Where growing on hills it flowers earlier than trees on flats.

One of the Mallees	*E. leptophylla*, F. Muell.	Occurs throughout wheat belt and mallee areas and on the lee side of limestone hills in the coastal areas.	Good, light and thin	Poor	Unknown	December to January flowering, not enough known about this mallee to be definite.
Yate	*E. cornuta*, Labill.	Grows on best soils and is therefore almost cut out in wheat belt. A few stands left in the S. Coast and drier S.W.	Good	Good	Believed to be good, but no information	There is little information about this tree, except that it is worked by some beekeepers. Flowers December to January.
Lerp Mallee	*E. incrassata*, Labill.	Wide spread throughout southern areas, in the mallee-wheat areas	Good	Good	Good	There is a doubt about the flowering time of this tree, although it seems to flower over a long period. The main period seems to be in the winter.
Coastal Blackbutt not to be confused with the S. Coastal Blackbutt	*E. Todtiana* F. Muell	Grows in the poor sands of the W. Coast	Poor	Good	Good	It is an excellent shade tree and under pasture conditions produces freely. Otherwise is most uncertain; it is believed but not known that the buds are two years old when they flower.
Paperbark Tea Tree with flat leaf	*Melaleuca parviflora* Lindl.	Swamps and river banks in the South-West	Poor	Good	Good	This is a heavy concentrated flow for two weeks from Xmas till mid-January.
Tea Tree	*Melaleuca* .... Huegelii Endl.	Limestone ridges on coast	Good (?)	Excellent	Good	Flowers November, December and January. Spike has a purple tip and the plant is usually a shrub.
Red Bell, Silky-leaved Blood Flower	*Calothamnus sanguineus* Labill.	Widespread in the Midlands, Gt. Southern and along Darling scarp	Dark, good quality	Excellent	Good	Flowers over a long period.
Silver or Yellow Banksia	*Banksia attenuata* R. Br.	Grows on poor sands	Poor	Good	Good	There is an element of doubt here as good flows reported could have come from other plants.

It will be seen from this list that information concerning many nectar-bearing plants is far from adequate. We would appreciate further information from beekeepers.

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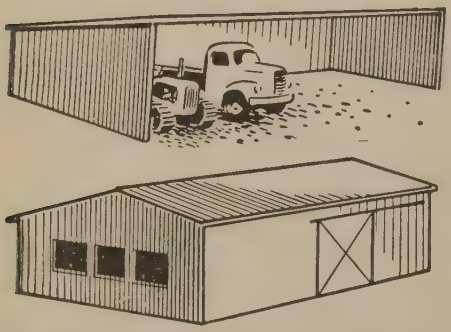

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TRACTOR

Testing in Australia

PART 2

By G. H. VASEY, B.C.E., A.M.I.E. Aust., Officer-in-Charge of Tractor Testing, and W. F. BAILLIE, Dip. Mech. Eng., Dip. Elect. Eng., Testing Officer, University of Melbourne

THE TEST PROCEDURES

AUSTRALIAN test procedures,* though differing in some details, and in some ways going further and telling more about the tractor, conform in essentials to overseas standards. The tests are in four main parts—

(a) the physical properties of the tractor;

(b) the power of the engine, and its stationary outlets—the belt and the p.t.o;

(c) the power on the drawbar when working on a formalised test surface or track;

(d) the reliability of the tractor when running under test, and its condition after the test.

PHYSICAL PROPERTIES AND PROPORTIONS

The first thing is the identification of the tractor, from engine number to weights and dimensions; checking the fuel pump delivery, analysing the fuel used in the tests. Among the dimensions, for example, are the ground clearance, length, width and height.

The position of the centre of gravity is found; turning circles are run and measured; p.t.o. speed and style are compared with international standards; so also is the linear speed of the belt.

The wheel equipment is examined, added ballast checked; the total weight and tyre pressures are checked against the weight recommended for use in the field.

If the tractor works through an automatic linkage that can continually support an implement while at work, a static test is run to decide what ballast may fairly be added to the (light weight) tractor, so as to represent in the test the weight transferred from the implement.

The seat and controls are tried for accessibility and comfort; the usefulness of the instruments is noted throughout the running of the tests.

The sum total of these critical observations, and the reporting of them are an important part of the treatment, since they represent those features of the tractor that the user is immediately concerned with. Most users are rightly more interested in these than in the power output, provided the power is enough.

But if the tractor is uncomfortable, noisy, hard to steer, awkward to handle,

* The Tractor Testing Committee, which controls the Australian scheme, is a joint body established by agreement between the Commonwealth, the States, and the University of Melbourne; under this agreement, the tests are carried out by the University of Melbourne. The address of the Tractor Testing Committee is: C/o Department of Primary Industry, 301 Flinders Lane, Melbourne, Victoria.

The drawbar test vehicle

inconvenient in its controls, then the user of it has to put up with a lot of hardship all the time he is on it, even though it may do his work for him.

THE POWER UNIT—DIRECT ENGINE TESTS

Since the modern tractor is in effect a mobile power plant, with a power unit—the engine—and several power outlets in the belt pulley, p.t.o., hydaulics and drawbar, it is important to know the performance of the engine itself, the source of power.

Though the power put out by any of the outlets must necessarily be less than the corresponding power of the engine, the performance of an outlet will of course reflect and correspond to the performance of the engine.

(a) Full Power at Rated Speed.

The first step therefore is to measure the performance of the engine itself. For this purpose the engine, complete with all auxiliaries and controls, is taken out of the tractor, set up on a test bed, and direct coupled to the torque dynamometer. In this way the torque* on the engine shaft, and the power output at the engine shaft (shaft horsepower, s.h.p.)** are directly measured. Maximum engine power is established by running a test for two hours, at full power (i.e., the fuel supply not restricted by the governor) at rated speed, shown at A in Fig. 1.

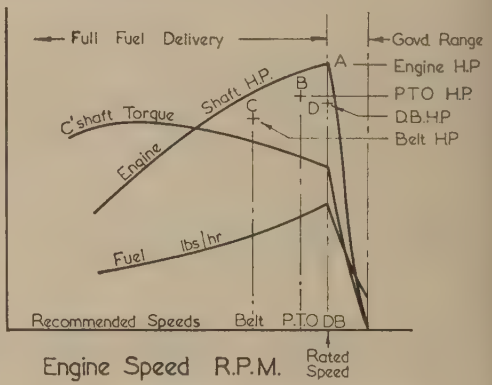


Fig. 1.—Performance of Engine and Outlets.

Note 1: *Engines of the Same Model not Identical.*—For any production model of engine (or tractor) the maximum power output at rated speed of the individual units cannot be exactly the same; over the whole production or stock there must be a variation, that might amount to plus or minus five per cent.—in effect a manufacturer's tolerance. Since the top value of this range can be reached only by perhaps 1 in 50 engines, to quote the top value alone is doubly misleading—it implies that all engines are alike, and all at top value.

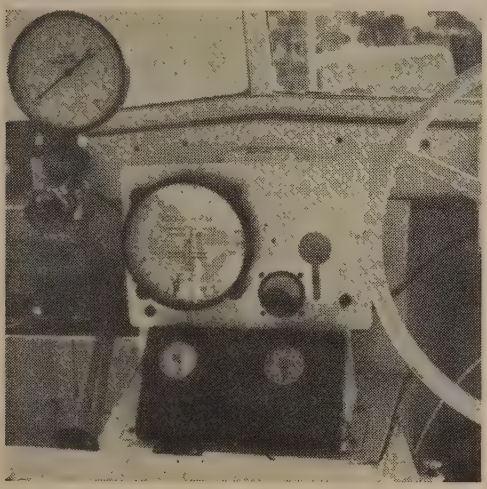
To bring the test to realities, it is sufficient to see whether the maximum shaft h.p., found in the test just described, on the random sample, falls within the range of expected values nominated by the

* TORQUE in the shaft is the twisting movement that drives things connected to the shaft. It is the product of tangential force and radial distance from the centre of the shaft; for example, any combination of force and distance whose product is say 100, means a torque of 100 ft. lb.

** POWER in a shaft is the product of torque and rotational speed. In horsepower units, shaft horsepower (shp) $= 2\pi \times$ torque $\times$ speed (rpm) $\div$ 33,000. This comes to shp $=$ torque $\times$ speed $\div$ 5,250.

manufacturer. The manufacturer is asked, in the Conditions of Test, to nominate this range. This test therefore is in the true nature of a formal acceptance test.

Note 2: *Avoid "Bare Engine" Power.*—Some engine companies are apt to quote what they call brake h.p. on the bare engine, that is without fan and generator, and possibly without water pump. Since these essentials may account for 3 or 4 h.p. in a 50 h.p. engine, the value is misleading (and confusing, even if the term "bare engine" is employed to make the meaning clear).



Instrument panel inside the test vehicle

Note 3: *Avoid "Brake" H.P.*—A further confusion comes from the use of "brake h.p.". Brake simply means that the power is absorbed and measured on a torque brake or dynamometer, as it always is. The important thing to say is where, on the engine or its outlets, the power is measured. Hence shaft h.p. (better than flywheel h.p.) is the only proper term for this. There is no occasion for brake h.p., or for b.h.p. since this may be confused with belt h.p.; for this latter it is better to spell it out, as belt h.p.

Note 4: *Rated Speed Important.*—A speed of special importance in governed engines is rated speed this is the speed nominated by the maker (usually in round numbers like 1600, 1750, 2200 r.p.m.) as the recommended speed for running more or less continuously at full output. Maximum power, as a characteristic measure of governed engine performance, is only meaningful when measured and quoted at rated engine speed; its full title is "Full-power-at-rated-speed."

Note 5: *Fast Idling setting of Governor.*—For the purposes of formal test, it is essential to establish full, or maximum power in this way, namely at rated speed; this is so, notwithstanding the practice sometimes employed of providing a fast-idling setting in the governor that may bring the engine on to full power at above rated speed. This fairly ensures that full power is available at rated speed, perhaps with something to spare; but the procedure is not intended to take any account of the "something to spare." Equally fairly, if the fast idling setting does not yield full power at rated speed, the setting will be raised accordingly.

(b) Governed Speed Running.

At part loads, the governor takes over, allowing the speed to rise eventually—at no load—to fast idling speed. A series of tests is run, at part loads, to see how speed and fuel consumption vary under the governor. This is called running under the governor, or in the governed range, shown to the right of rated speed in the graphs of Fig. 1.

(c) Full Fuel (Full Throttle) Running.

Starting again at full load and rated speed, as the load, i.e., the torque, is still further increased, the governor keeps the fuel open, so the speed will fall, down to the lowest available speed. At about half rated speed the torque output will reach its maximum; maximum torque, and the rise in torque output from full load at rated speed are points of some interest, since they indicate "lugging" capacity.

A series of tests is run in this region of performance so as to establish the full torque characteristics, shown to the left of rated speed in Fig. 1.

(d) Part Loads, Lower Speeds: Best Economy.

By resetting the governor at a succession of lower speeds, the whole part-load performance of the engine can be traversed so as to reveal that combination of load and speed that runs at best economy, a

point of some interest when farm tasks require only a fraction of the full output of the engine.

Note 6: *Fuel Consumption—Specific Fuel Consumption.*—Fuel consumption is measured during all of these tests; this is stated in the report in a variety of ways.

Though the simplest unit may be gallons per hour, this takes no account of load or whether the engine is doing much or little work at the time. A much better indication of fuel performance is the specific fuel consumption: this is quoted in lbs. per s.h.p.-hour, which should be low for good economy, or s.h.p.-hour/gallon, which of course should be high.

Specific fuel consumption enables us to compare the economy not only of one engine at various loads; but of one engine with another regardless of differences in type and size. How specific fuel consumption varies with power output on both governed and full throttle running is shown in Fig. 2.

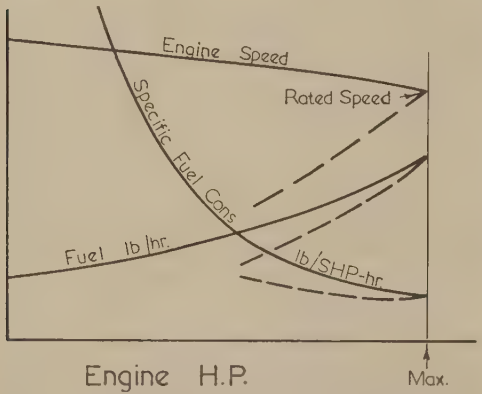


Fig. 2.—Engine Performance in Governed Range (full line) ———; at Full Fuel Delivery (broken line) — —.

OTHER STATIONARY OUTLETS—P.T.O. AND BELT

(a) P.T.O. Power.

When the engine has been put back into the tractor, a full power test on the p.t.o. outlet is run, i.e., with the p.t.o. direct coupled to the dynamometer, and with the governor control set to run the engine at full power at the speed required to give the specified or standard p.t.o. speed. (This engine speed may or may not be rated speed). This test is shown as the single point B in Fig. 1.

(b) Belt Power.

Similarly by coupling the belt pulley to the dynamometer by a suitable belt, a single test of full power on the belt outlet is run; again the governor control may have to be reset so as to run the engine at the speed recommended for belt work, or at the speed required to run the belt at the standard linear speed (3,100 r.p.m.). This test is shown as the single point C in Fig. 1.

Note 7: *Change in Test Codes.*—In other testing stations, and in the Australian tests up to 31, the belt outlet was used as the only means of testing the engine. Other testing stations use, or shortly will use the p.t.o. instead of the belt outlet as the main test; if there is no p.t.o., then the engine will be tested directly on the crankshaft as described above. Clearly the trend is away from the belt outlet and towards the direct engine test as the main test in the series.

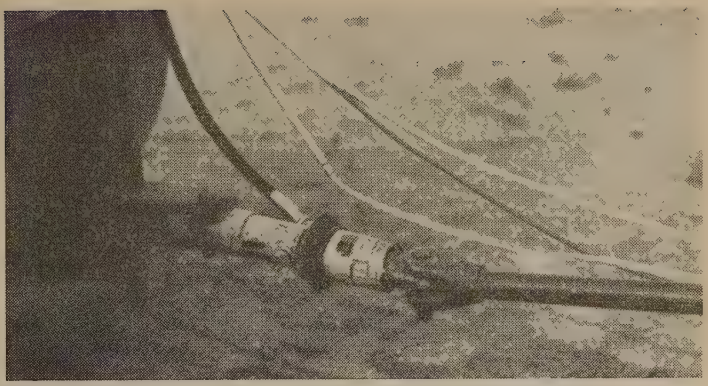
Note 8: *Ambient Conditions during Test.*—Throughout the tests, especially the longer runs of 20 minutes, 1 hour and 2 hours, the temperature and barometric pressures of the ambient air are observed, as well as the temperature of the radiator water, and of the lubricating oil and fuel. It may be necessary to avoid testing, at any rate for the purpose of establishing maximum power, on days that are particularly hot or particularly cold. On the other hand, it would be fair to introduce a test at high air temperature, say 100° F, to see how performance may suffer in the hot weather.

TESTS ON THE DRAWBAR

(a) Introduction.

Drawbar power is, by definition, the product of pull and speed; in particular d.b.h.p. = Pull (lbs.) × Speed (m.p.h.) ÷ 375. To apply a drawbar load to a tractor it is necessary only to cause it to pull something.

For test purposes the load is a special vehicle whose resistance to pulling can be varied at will (rather like applying a brake to the towed vehicle). The pull in the towbar is measured, for example by a hydraulic cylinder and pressure gauge, while speed is measured by timing the tractor over a measured course on the



The drawbar dynamometer, showing fuel lines to the tractor and electric cable from tractor to the instrument panel in the vehicle

test track. In any event, no statement about d.b. power and pull are meaningful unless the weight of the tractor (total and rear axle loads) and height of drawbar are also quoted.

(b) Test in each Gear.

For each gear (except the high speed road gear) in a series of runs over measured courses of 200 to 500 ft., the load is steadily increased until full engine power and rated engine speed are reached. As the pull is still further increased, the speed will fall rapidly corresponding to the full torque/speed characteristic of the engine, until a maximum sustained pull is reached, corresponding to maximum torque in the engine.

These characteristics of d.b.h.p. are shown in Fig. 3 for the several gears (above the low gears mentioned below) by the sloping lines leading to the peaks, followed by the hooks down to and past the maximum sustained pulls.

(c) Maximum d.b.h.p. defined by Rated Gear.

Although these peaks of d.b.h.p. in the various gears may not be equal in value, it is the peak in rated gear that defines, for the tractor, the maximum d.b.h.p. where rated gear corresponds to the speed of heavy farm work, e.g., ploughing, at about 3 m.p.h.

It will be noted that maximum d.b.h.p. will be less than maximum engine power : naturally, because of the losses in the transmission and in the wheels, including slip : point D in Fig 1 and in Fig 3.

(d) Low Gear Output limited by Slip.

An exception to this behaviour will (usually, i.e., unless the tractor is specially and improperly heavily weighted for the purpose of the test) appear in the low gear or gears, where the heavy pulls cause the wheels to fail by slip before the engine is fully loaded; in those circumstances neither full engine power, nor full d.b. power is reached. This situation is shown by the low gear curve in Fig. 3. Nevertheless, it is usual for the pull at the "hill" of this curve to be higher than the pulls available in the higher gears.

(e) Ten-hour Test.

Rated gear is then chosen for a much longer run—the 10-hour test, still on the test track. In the original Nebraska tests, this run of 10 hours was done under a fairly high drawbar pull—three quarters of maximum for the rated gear. The idea was to see whether the tractors could run continuously for that long—many of them failed to do so.

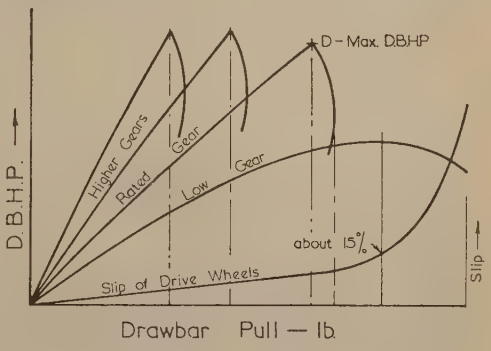


Fig. 3.—Drawbar Performance in the Gears.

The Australian test splits it up into 4 x 2½-hr. sessions, the sessions being run at four different loads from nearly full load down to below half load. Clearly, in modern tractors, this arrangement does not particularly look for failure in 10 hours of running, but gives values of fuel consumption at a variety of likely loads on 2½-hr. runs.

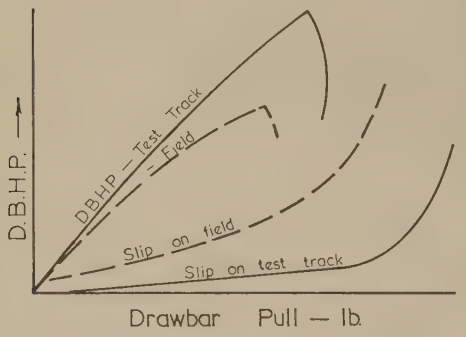


Fig. 4.—Typical Difference between Test Track and Field.

Note 9: *Warning on Drawbar Values.*—Performance on field soils, unless they are hard and dry like the test track, will be different from the performance measured in the test: pulls will be less and slip more. Fig. 4 suggests the sort of differences in pull, slip and d.b.h.p. that might arise in a given gear on some unspecified soil.

RELIABILITY DURING TEST: FINAL INSPECTION

Before the test is started, the tractor, being new, is given the usual pre-sale checks and treatment such as the vendor is supposed to give for the purchaser; and being new, the tractor is run-in for an arbitrary period of 12 hours before applying the formal tests.

Defects and mishaps that occur at any time during the tests, requiring adjustments or replacement of parts, are of course corrected and noted in the record.

New oil is charged to the engine after run-in, and drained out at the end of tests, the weight of oil at start and finish being noted. Similarly the weight of cooling water added during the tests is noted.

The total time of running is added up from the daily logs; in an average test this would amount to 50 or 60 hours, including run-in.

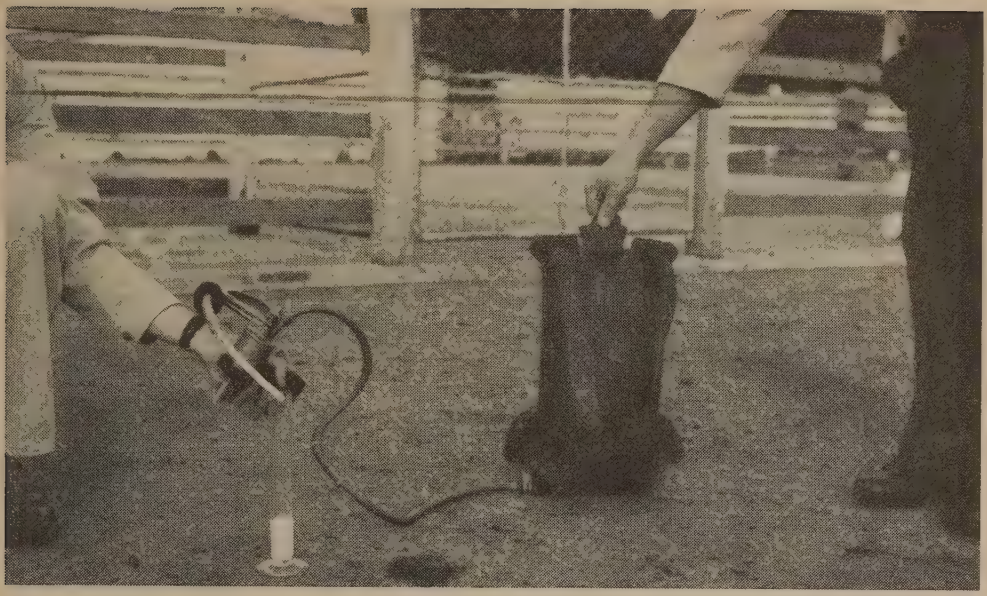
After the tests, the tractor is partly stripped down: the engine head and sump removed, valves and pistons withdrawn, transmission covers taken off, so that any obvious signs of undue wear or overheating can be detected after so many hours of running.

TEST REPORT

The whole series of events is recorded in a formal report which would show in tables the full power values on the crankshaft and at the outlets, as well as the performance shown in the graphs of Figs. 1, 2 and 3, and other graphs also. As well as giving a brief specification of the tractor the report will state the manufacturer's expected range of values for full engine power for this model.

While the information on the properties and proportions of the tractor, and on the tests of the engine and its stationary outlets, will need no particular interpretation (they will behave the same way in general use), tests on the drawbar must be interpreted in the light of Fig. 4 and Note 9.

Though the Technical Report is limited in numbers, the briefer Farmers' Edition is readily available throughout Australia, at State Departments of Agriculture and offices of the Department of Primary Industry.



HOW EFFICIENT IS YOUR DRENCHING GUN?

Does it Deliver Sufficient Drench to Kill the Worms?

By THE VETERINARY BRANCH

THE drenching gun pictured certainly doesn't. It is set to give two fluid ounces of drench (60 ccs approximately). However, when tested by squirting the fluid into a measuring cylinder, instead of down the sheep's gullet, it delivered only 30 ccs. That is, every sheep drenched with this gun, received only half the quantity of drench required to kill the worms. This amount would kill very few worms so the cost of the drench used would be wasted and the sheep would still have worms causing further economic loss.

The reason in this case was certainly not the fault of the gun's mechanism, but was due to the fact that phenothiazine had collected around the plunger, preventing complete refilling. Once the gun was cleared it worked efficiently.

This is an extreme case but certainly not an isolated one. Of the small number of guns checked on farms very few have delivered the correct dosage.

Automatic drenching guns are very valuable in making the drenching of sheep a relatively easy and quick job, and their use is certainly not to be condemned. They have however a complex working mechanism which is easily interfered with if not cared for and kept clean.

Is your drenching gun dirty and inefficient? Why not check it before you next start drenching your sheep to see if it is delivering the correct amount of drench?

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Nitrophoska Red is the *complete* fertiliser, containing all the nutrients most important for plant growth — nitrogen, phosphoric acid and potash, together with trace elements. Each pellet contains a chemically-blended, precise balance of the necessary elements. Nitrophoska Red is easy to handle, cheap to transport and requires little storage space.

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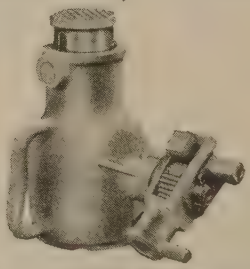

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TEASER (Vasectomised) RAMS

A Management Advantage

By W. L. McGARRY, Officer-in-Charge, and
I. K. STOTT, B.Sc. (Agric.), Adviser, Sheep and Wool Section

WITH normal late spring-early summer matings (October-December) teaser rams, correctly used, will give a more concentrated lambing. This has been shown under Western Australian conditions in trials conducted at the Wongan Hills Research Station. In one experiment a group of 100 ewes which had one per cent. of teasers for 14 days before the fertile rams went in, dropped 42 lambs in the first two weeks of lambing, compared with 17 lambs from 100 ewes that were not teased. The use of teasers in all Research Station flocks is now routine practice.

INTRODUCTION

Even though some breeds of sheep have more definite breeding and non-breeding seasons than others, all of them have periods of maximum and minimum breeding activity. Oestrus or breeding activity in the Merino ewe flock is generally at a minimum in the late winter and early spring. In the late spring-early summer it begins to rise and keeps rising until the autumn—declining again in late winter.

This is a definite cycle (thought to be governed by the length of daylight) which occurs every year. British breeds and crossbreds generally commence their breeding season later and have a more definite breeding and non-breeding season but the same principles apply.

It has been shown that during the period of transition from minimum to maximum breeding activity the presence of a ram in the ewe flock will stimulate oestrus or heat, i.e., the presence of the ram will speed up the transition. Usually this first oestrus is what is known as a "silent oestrus"—eggs being produced by the ewe, which doesn't show normal symptoms of heat (willingness to take the ram, etc.). This accounts for the common pattern of autumn lambing—a few lambs for the first two to three weeks followed by the bulk of the drop and the unavoidable "tail." In fact, the rams during the first 2-3 weeks of mating have been mainly stimulating the ewes into an egg producing silent heat or oestrus, which is followed 17 days later by the fertile mating.

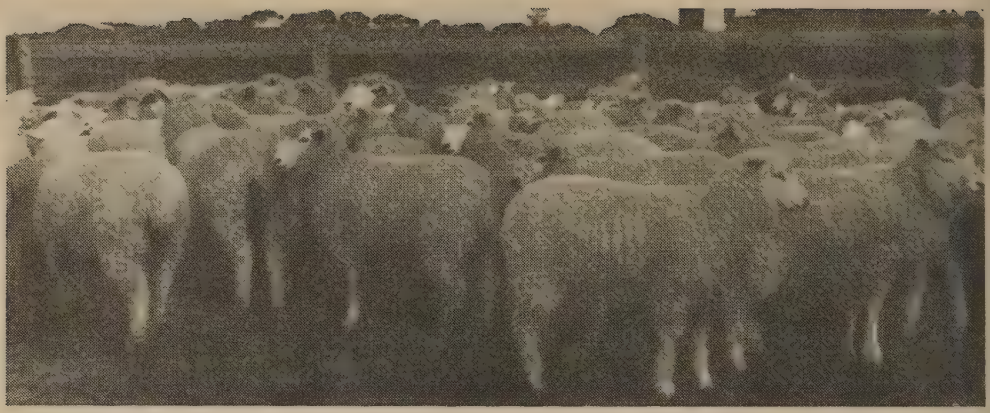
For this reason "teasers" are used.

A "teaser" (vasectomised) ram is one that has been rendered infertile by the removal of a small piece of the cord which carries the sperm from the testicles. The cord, gristly and white and about $\frac{1}{8}$ in. in diameter, is known as the vas-deferens and hence the operation of removing a piece of it is known as vasectomy. With the vas-deferens incomplete the ram cannot pass sperms and is infertile, although it still has all the normal male attributes. Hormones are still passed through the blood vessels and the ram still has normal mating desires.

These "teasers," normal in every way except they cannot cause conceptions, can then be used for preliminary stimulation of the ewes during the transition period, causing a bulk of ewes to be showing fertile oestrus when the fertile rams are put in, resulting in a quick, concentrated lamb drop at the due date.

A drop such as this has many management advantages some of them as follows:—

(1) A concentrated drop means concentrated management in the vital early stages of the lamb's life.



Three and a half months old Border Leicester cross lambs from teased ewes at Wongan Hills Research Station. Lambing was mid May, 1958

Better attention, better feeding programmes, better fox control and easier handling.

(2) For wheat-sheep farmers the bulk of lambing can be practically over before seeding which can and does clash with lambing.

(3) For fat lamb breeders an early concentrated drop means bigger drafts of lambs on the early markets.

(4) An even drop gives easier more accurate classing as 2-Tooths.

(5) More effective use of fertile rams.

(6) Facilitates earlier weaning if desired.

MATING TRIAL. USING "TEASER" RAMS

Wongan Hills Research Station—1958

Following upon our recommendations, many flock owners have used "teasers"—most of them with good results. To get accurate figures of the comparison between teased and unteased flocks a trial was commenced at the 1957-58 mating.

Two hundred 6-tooth and full mouth Merino ewes were divided at random into two-even groups.

Group 1.—Were mated with "teasers" on November 13th. Teasers were removed on November 27th.

Group 2.—Were not teased and were the control group.

Both groups were mated with 3 per cent. fertile Border Leicester rams on November 28th. These were removed on February 6th.

Until one month before lambing the groups were run together at this date they were divided into their original groups and placed in adjoining paddocks.

Lambing commenced on April 24th. Within the first three weeks Group 1 (teased group) had dropped 54 lambs and Group 2 (control group) 40. The pattern of the drop was:—

Week of Lambing	Group 1. (teased) Lambs Dropped	Group 2. (not teased) Lambs Dropped
1st	15	8
2nd	27 (42)	9 (17)
3rd	12 (54)	23 (40)

Lambing continued for a further 6 weeks and both groups finished with a similar marking percentage of over 80 per cent.

Lambs in each group were weighed at 3 and 6 months from the commencement of lambing. Both groups were run under the same pasture conditions.

	Average Weight of Group 1 (teased)	Average Weight of Group 2 (not teased)
At 3 months	54 lb. 4 oz.	45 lb. 15 oz.
At 6 months (ewes only)	82 lb. 8 oz.	75 lb. 2 oz.

These weights illustrate the advantage of using "teasers" in getting more lambs to market weights earlier in the season. Wool weights of the ewe lambs (shorn 9th September) were:—an average of 3 lb. 8 oz. in Group 1., and 1 lb. 3 oz. in Group 2.

This also illustrates that through their more concentrated earlier drop, the teaser group lambs, being more advanced in growth cut more wool up to shearing. This

would be advantageous if the lambs were sold off shears.

In the early part of mating the Border rams appeared loath to work and it is considered that had Merino rams been used there would have been more lambs and greater differences between the groups in the first 3 weeks of lambing. This was supported by records kept at Newdegate Demonstration Farm during 1959 lambing. "Teasers" were used with Merino ewes in the farm flock before they were mated with Merino rams. From a flock of 250 ewes 203 lambs were dropped in the first 18 days from the date lambing commenced—total drop was 212 lambs.

CONCLUSIONS

These figures and the experience of many farmers who have used "teasers" show that they are well worth while in all flocks that are mated in late spring-early summer (October-December). Teasers are of no advantage in an autumn mating.

To use "teasers" in any flock is simple and inexpensive. They are put in 14 days before the fertile rams at the rate of one per cent. After 14 days they are removed and for the rest of the year they can be kept in the ram paddock.

Merinos are the best to use. They are readily obtainable, vigorous and the fleece they grow pays for their keep. Young culls from a stud or a few ram lambs reserved from a commercial flock are a source of supply. Do not rely upon ear tags to identify teasers—tags can become lost! Definite identification such as shortened horns, long tails, etc., is a necessary safeguard.

The operation, best done when the ram is a two tooth, is not difficult to perform. Having been shown the technique farmers can usually do it themselves. A demonstration can be arranged by contacting your local Agricultural Adviser or the Officer-in-Charge, Sheep and Wool Section, Department of Agriculture, Perth.

Above is shown a boom loader with a drum loader attachment, lifting a drum of honey from the ground to the truck. Drums of honey weigh approximately 700 lb. and are extremely difficult for one man to handle.

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MURESK AGRICULTURAL COLLEGE

(Department of Agriculture)

Parents are reminded that applications for 1962 admission to Muresk Agricultural College close on December 31 of this year. A preliminary selection of 1962 entrants is made after the Junior results are available early in 1961.

The successful applicants then continue with Sub-Leaving, or higher studies, in 1961.

Before the course can be commenced students must have attained:—

(a) Sub-Leaving Standard in English, Maths. A, Chemistry and Physics (including Magnetism and Electricity if possible).

(b) Junior Standard Bookkeeping.

Should places still exist for 1962 commencement after the preliminary selection early in 1961, they are filled in order of application during 1961, by qualified applicants.

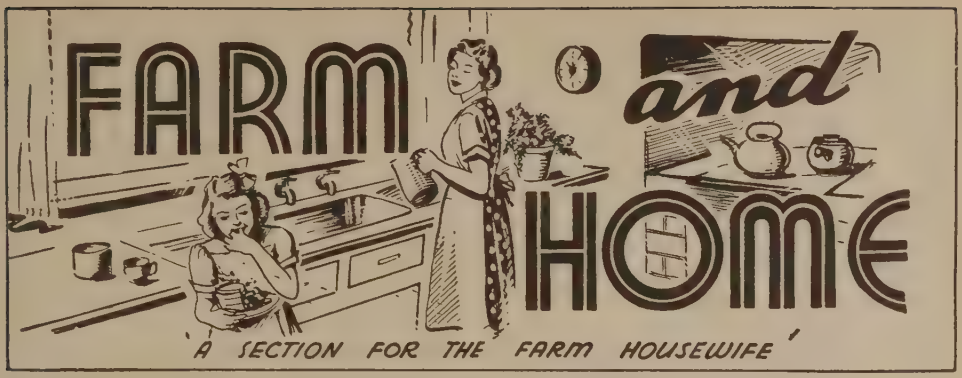
Duration of Course.—Two years.

Fees.—Approximately £180 per annum covering full residential charges.

Scholarships.—Department of Agriculture (3), the "Countryman," and J. J. Poynton Memorial (2).

Boarding Allowance.—Most Muresk students are eligible for the Education Department Boarding Allowance (£50 per annum).

Full details of the College are obtainable from the Principal, Muresk Agricultural College, Muresk, W.A., or the Department of Agriculture, Perth.



A Happy Christmas to Housewives

By HELEN M. GLOSTER

THE Christmas season is at hand once more and the housewife will be confronted with the problem of providing appetising meals for various occasions. Breakfast on Christmas morning may become a difficult meal in some households as the normal daily routine is naturally disturbed by a general mixture of church going, the excitement of young folk opening presents, the exploring of Christmas stockings, the door bell ringing with callers, and preparations for Christmas dinner.

With planning and early preparation beforehand it is possible to provide a nourishing and appetising breakfast which will free the housewife for church, joining in the general family celebrations, or anything else she plans to do.

The table may be set early and the food covered, then placed in readiness on the table. Individual members of the household will be able to help themselves when they are ready, without inconvenience to the housewife, apart from the occasional renewal of the teapot.

Here is the menu:

Cold ham (baked or boiled some days previously), or

Stuffed Vienna Roll.

Cold hard boiled eggs.

Scones (kept warm in the oven).

Bread.

Butter.

Marmalade.

Fresh fruit.

Tea. Milk for children.

TO BOIL HAM

Ingredients.

A piece of cushion of bacon (4 or 5 lb.) or a piece of ham.

Brown dry breadcrumbs.

Nutmeg.

Method.

Wash bacon well in cold water, then place in a large saucepan and cover with cold water.

Bring to the boil and pour off water.

Add fresh water and bring to the boil again.

Simmer 2½ to 3 hours being careful not to cook too quickly.

Leave in the pan to cool sufficiently to handle.

Remove from pan and peel off rind. (This should come away easily if meat is cooked).

Sprinkle the fatty surface with dried breadcrumbs and grate over a little nutmeg.

N.B.—If a larger or smaller piece of ham or bacon is used, allow 30 minutes for every

pound of meat plus 30 minutes, taking the time from the moment the meat comes to the boil.

BAKED HAM

Method.

A stiff paste is made of flour and water.

This is rolled out thinly and wrapped around the ham, entirely enclosing it.

Ham is sewn into a muslin bag (a clean worn flour bag will do).

Meat is then weighed and baked in the oven with a little fat in pan.

Time for cooking is 30 minutes for every pound plus 30 minutes.

Ham should be basted occasionally.

Allow to cool then remove flour crust and peel off skin.

Sprinkle with dried brown breadcrumbs and a little grated nutmeg as in previous recipe.

N.B.—Ham baked in this way is superior in flavour to boiled ham as the flavour of the meat is protected by the coating of paste.

To Serve.

Carve into thin slices and arrange on a meat dish or leave wrapped in waxed paper until required. When serving garnish with parsley.

Mixed mustard should be served with the ham.

STUFFED VIENNA ROLL

Ingredients.

1 large Vienna loaf.

¼ lb. butter.

½ lb. cooked ham or a mixture of cold cooked meats.

A little salad dressing or sauce.

Method.

Cut the ends from the loaf and with a sharp knife, scoop out most of the soft bread. Work from both ends until loaf is hollow.

Smooth the inside and spread with butter.

Mince the meat, mix with some of the soft breadcrumbs and bind with salad dressing or sauce. (Any sauce or a mixture of sauces will do.)

Blend the mixture thoroughly then pack into the loaf so that it is filled with mixture.

Wrap in waxed or greaseproof paper until required.

Cut into ½ inch slices and arrange on a plate on a bed of lettuce leaves.

N.B.—These rolls may be prepared on Christmas eve and left ready in the refrigerator.

They are also excellent for packed lunches, picnics, and alfresco teas.

HARD BOILED EGGS

These may be cooked early on Christmas morning or prepared the evening before hand.

Method.

Place eggs in cold water and bring slowly to the boil.

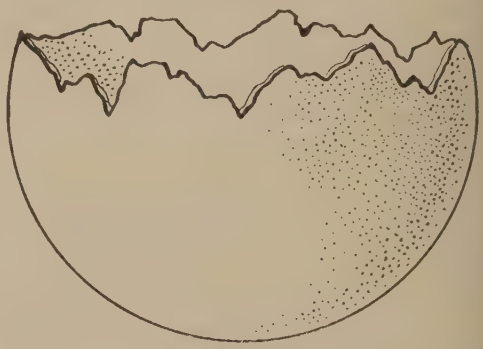
Boil for ten minutes.

Lift out and crack the shells then plunge eggs into cold water and leave to cool. (This prevents the discoloration around the yolk.)

Peel off the shells.

If liked eggs may be cut in two making a scalloped edge to each half.

Arrange on a plate.



SCONES

Make the scones on Christmas eve and leave to warm in the oven shortly before breakfast.

Try one of these recipes:

SWEET SCONES

Ingredients.

2 cups self-raising flour.

½ level teaspoon salt.

2 level tablespoons butter or margarine.

2 level tablespoons sugar.

1 egg, milk (to make about ¾ cup).

SPICED SCONES

Ingredients.

2 cups self-raising flour.

½ level teaspoon salt.

2 level tablespoons butter or margarine.
½ level teaspoon ground cinnamon or mixed spice.
3 level tablespoons currants.
3 level tablespoons sugar.
¾ cup milk.

OATMEAL SCONES

Ingredients.

3 oz. fine oatmeal.
7 oz. plain flour.
4 level teaspoons baking powder.
½ level teaspoon salt.
2 oz. butter, margarine or margarine and lard.
2 level tablespoons sugar.
Milk to mix (about ½ cup).

Method.

Sift the fine dry ingredients. This includes flour, salt, oatmeal, baking powder, cinnamon according to recipe being used.

Rub fat into flour with finger tips.

Wash and dry currants.

Add currants and sugar to flour mixture, mix well.

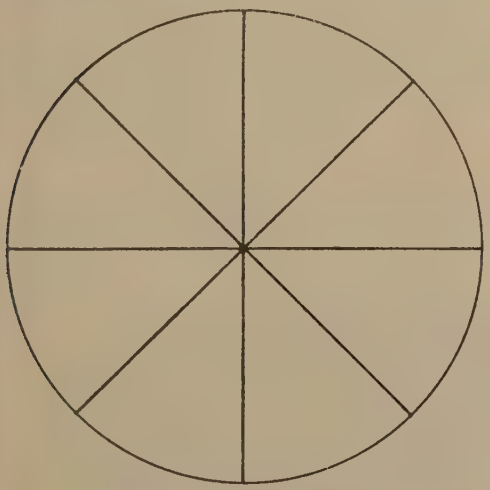
Beat egg and mix with milk.

Stir in sufficient liquid to make a soft dough.

Knead slightly and roll out ½ in. to ¾ in. thick.

Cut into rounds.

Place on a hot lightly floured baking tin, glaze with milk.



Round divided into segments

Bake in a hot oven until well risen and browned.

Oven temperature 450° F.

Time to bake—about 10 minutes but varies according to size of scones.

Variations.

Egg may be added to, or omitted from, any scone mixture.

Extra fat may be added to a scone mixture. It makes a richer scone which will not stale as quickly as a plainer mixture.

Spiced scones are best if rolled into a round and cut into 8 or 12 segments (according to size of rounds).

These scones may be cooked together as a bun or segments may be separated before cooking.

N.B.—Scones should NOT be cut with a knife. They should be split in two with the fingers before buttering.

THE ZIPPER-UPPER

Have you a zip which is difficult to fasten? Perhaps you have a frock with an opening and zip at the back and have difficulty in fastening it.

The "Zipper-upper" is the answer to your problem and is very simple to make.

You will require—

A metal "tongue" from an old buckle (about 2½ in. in length if straightened).

A one inch brass curtain ring.

Some soft coloured string or macrame.

No. 11 Aero crochet hook.

Small pliers.

Method.

Make sure the end of the "tongue" will slip into the slot on the end of the zip.

Bend one end of the "tongue" to form a hook the other end to make a circular eye.

Using a No. 11 crochet hook and string make 75 chain stitches.

1st Row: Miss first chain and work a double crochet into each chain stitch.

2nd Row: Work back along the strip with a double crochet into each stitch.

End off by fastening to the hook through the eye.

Sew in the loose ends securely.

Using string cover the curtain ring with blanket stitch. Knot the loose ends together then join securely to the free end of the "Zipper Upper."

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The new AGSERV HY-PUT sets the pace in hammermills, giving greater output at lower cost. One of the HY-PUT's important features is its extra large feeding mouth into the grinding chamber. This greatly reduces the "teasing" of sections of baled material and helps make the AGSERV HY-PUT the ultimate in mechanised fodder production.

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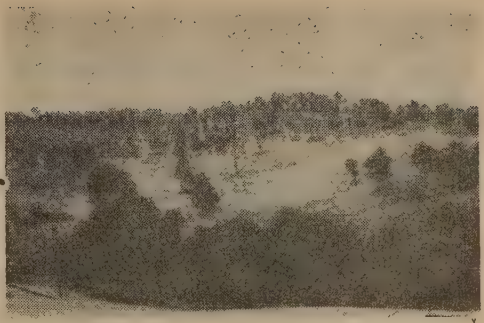


Part of the Bridgetown area—note the amount of "cover"

The Success of The Rabbit "Killer" Trials

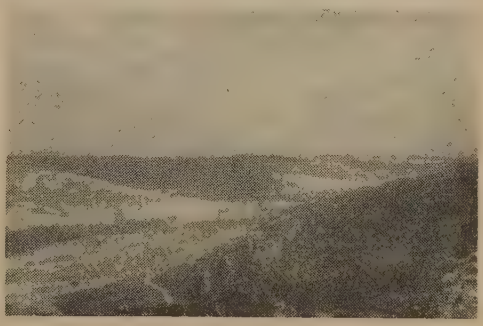
By A. R. TOMLINSON, Chief Vermin Control Officer

SUCCESS well beyond what was anticipated has been achieved in a two year trial of a modified version of the rabbit "killer" method. In the "killer" method, trained officers are employed to kill rabbits instead of to inspect and supervise the activities of farmers and, in fact, these officers do all the actual work of destruction. This system was advocated by the W.A. Royal Commission which reported on Vermin Control in this State in 1944, and it was used successfully in New Zealand. These trials were applied only to poisoning and not to overall destruction measures. The main object was to see if rabbits could be brought under control and kept there by standard poisoning procedures.

The Agriculture Protection Board was prompted to arrange the trials by concern that, while rabbits were still well below the numbers before 1956, they had obviously increased in parts of the agricultural areas, largely due to a decline in the effectiveness of both myxomatosis and control work.

For one trial an area covering a group of 65 farms in the Bridgetown district was selected as including many of the problems

Typical Greenbushes area



Some of the Nannup country treated

encountered in higher rainfall (30 in. and over) rabbit infested regions. In fact, the area was as tough as could be found with partly cleared properties, steep hills, rocky outcrops, logs, bracken and other thick

Kellerberrin "killer" area. Typical notice in the centre foreground

cover. The other trial area comprised 49 farms in the Kellerberrin district, considered to be fairly representative of the lower rainfall (13 in.) wheat and grazing areas with large cleared properties and a relatively lower rabbit population.

PROGRAMMES FOLLOWED

Both the areas were carefully surveyed by Vermin Control Officer-operators and maps of the individual properties as well as the whole groups, were prepared with details of clearing, rabbit infestation, warrens, etc. All operations conducted on each property were recorded.

In Bridgetown a spring poisoning drive in 1958 was followed by summer drives in 1959 and 1960. Spot poisonings were carried out by the Vermin Control Officer

Preparing "1080" mixture for mixing with oats

between drives and until 30th June, 1960, wherever he found sufficient rabbits.

In Kellerberrin, an early summer drive at the end of 1958 was followed by spot poisoning until 30th June, 1960, wherever sufficient rabbits were found.

In both places, the Vermin Control Officer-operators made the trails, free fed with oats for three successive nights and poisoned on the fifth night. If it was considered results were not good enough, the process was repeated later. It was necessary to return to some properties up to five times to fit in with stock movement arrangements made by the owners.

Mixing the oats and "1080"

RESULTS

At Bridgetown, rabbits were considerably reduced in the 1958-59 work so that another spring drive was not necessary. The 1960 summer drive and spot poisoning then reduced rabbits probably to the minimum level which poisoning could attain and where they could do no real damage to pastures or crops. They were cleared right back to the immediate vicinity of warrens and other cover. Those remaining could be held at this level by the continued application of the "killer" poisoning on a reduced scale.

District Officers and farmers—some with properties both inside and outside the trial—estimated the rabbit numbers at the end of the 1960 summer to be held at a quarter or even less than those on neighbouring properties where exactly the same work was supposed to have been done by the owners.

While many warrens were inaccessible, a lot could be destroyed, which would reduce future control work proportionately.

Warrens on one rabbit netted property were totally ripped for £330 and the previous poisoning cost of over £300 was reduced to £30.

The cost of the work in the Bridgetown trial was £5,500 in the first year and £3,000 in the second year, representing 2s. 7d. a farm acre or £86 for the average 670 acre property, reduced to 1s. 5d. a farm acre and £46 a property in the second year.

Dropping "1080" poisoned oats into the trail

At Kellerberrin the results were just as good with a big reduction in rabbit numbers but, in relation to the population, proportionately more rabbits were left in warrens. The "killer" poisoning method could undoubtedly hold rabbits well in check but the trial showed very clearly that warren destruction is the really important measure in these areas.

Out of the 49 properties, 45 had warrens needing destruction at an estimated cost of £46 for the average 2,000 acre property. The poisoning costs were just under 6d. a farm acre in the first year or £49 a property, falling to slightly over 3d. a farm acre or £24 a property in the second year.

The trials have highlighted in a spectacular manner that rabbits can be brought down to and kept at a low level by standard methods, particularly poisoning. The difference between results obtained in the trials and those by farmers generally, lies in the consistently high standard of the work of the trained officers and their persistence in destroying rabbits whenever and wherever they were found. A noticeable feature was that two to three times more poisoning than normally done was carried out.

In high rainfall areas similar to Bridgetown, rabbits may be kept well under control by poisoning alone although all accessible warrens and cover should be destroyed as rapidly as circumstances permit. In lower rainfall areas similar to Kellerberrin, priority should be given to warren destruction with occasional poisoning when required.

It is evident from experience that no poisoning method except the "killer" system could obtain and maintain such satisfactory reductions and there can be

"1080" poisoned oats in trail

little doubt that this type of poisoning in conjunction with warren and cover destruction, especially, and other methods as well, is the only really effective way of dealing with the rabbit problem.

Some details of the trials are set out in the following tables.

SOME DETAILS AND COSTS OF TWO YEARS' OPERATIONS

(Including preparatory mapping, inspections, etc.)

——	Bridgetown	Kellerberrin
Number of farms	65	49
Total Farm Area	43,593 acres	100,076 acres
Largest Farm	2,700 acres	8,000 acres
Smallest Farm	50 acres	400 acres
Average	670 acres	2,042 acres

——	First Year	Second Year	Total	Average Per Year	First Year	Second Year	Total	Average Per Year
Total Cost	£5,535	£2,971	£8,506	£4,253	£2,407	£1,175	£3,582	£1,791
Cost per acre—								
Total Farm Area	2s. 6·47d.	1s. 4·36d.	3s. 10·8d.	1s. 11·42d.	5·73d.	2·94d.	8·67d.	4·33d.
Farm Area used	3s. 4·2d.	1s. 9·3d.	5s. 1·6d.	2s. 6·8d.	6·58d.	3·12d.	9·70d.	4·85d.
Average Cost per Farm	£86	£46	£132	£66	£49	£24	£73	£36 10s.

DETAILS OF OPERATIONS IN THE BRIDGETOWN "KILLER" TRIALS

1958–1959

——	Spot Poisoning and Spring Drive			Summer Drive and Spot Poisoning		
Date Poisoning commenced	15/9/58			9/2/59		
Date Poisoning ceased	12/11/58			30/4/59		
Number of Units	4			1 to 4		
——	Properties	Crown Lands and Reserves	Total	Properties	Crown Lands and Reserves	Total
Number of properties treated	57	9	66	57	9	66
Oats used (lb.)	14,400	720	15,160	14,480	620	15,100
Miles of Trail	580	32	612	601	29	630
Unit Working Hours	611	52½	663½	626	51	677
Average rate of application in each of the 4 applications (lb.)	6·4	5·6	6·2	6·0	5·3	5·9

The infestation on 8 properties was so low that no treatment was considered necessary.

1959–1960

——	Spot Poisoning			Summer Drive		
Date Poisoning commenced	1/7/59			12/2/60		
Date Poisoning ceased	30/6/60			30/4/60		
Number of Units	1			3		
——	Properties	Crown Lands and Reserves	Total	Properties	Crown Lands and Reserves	Total
Number of properties treated	14	2	16	58	12	70
Oats used (lb.)	743	58	801	10,576	724	11,300
Miles of Trail	44	4	48	414	29	443
Unit Working Hours	66	6	72	441	32	473
Average rate of application in each of the 4 operations (lb. per mile)	4·2	3·6	4·15	6·4	6·25	6·31

Only spot poisoning required on three properties and none on four others.

DETAILS OF OPERATIONS IN THE KELLERBERRIN "KILLER" TRIALS

1958–1959

	Spot Poisoning and Spring Drive			Summer Spot Poisoning		
Date Poisoning commenced	27/10/58			1/1/59		
Date Poisoning Ceased	30/12/58			31/7/59		
Number of Units	1–2			1		
	Properties	Crown Lands and Reserves	Total	Properties	Crown Lands and Reserves	Total
Number of Treatments	46	3	49	31	4	35
Oats used (lb.)	8,560	430	8,990	3,420	470	3,890
Miles of Trail	381	24	405	117	13	130
Unit Working Hours	520	29	549	....	....	....
Average rate of application in each of the 4 applications (lb.)	5·5	3·4	4·5	7·2	9	7·5

Infestation on three properties was not sufficient to require control measures.

1959–1960

	Early Summer			Summer and Autumn		
Date Poisoning commenced	5/11/59			1/3/60		
Date poisoning ceased	21/12/59			12/5/60		
Number of Units used	1			1		
	Properties	Crown Lands and Reserves	Total	Properties	Crown Lands and Reserves	Total
Number of properties treated	24	2	26	39	3	42
Oats used (lb.)	1,003	39	1,042	2,215	180	2,395
Miles of Trail	43	2	45	85	10	95
Average rate of application in each of the 4 operations (lb. per mile)	5·84	3·87	5·8	6·5	4·5	6·3

Total times were free feeding 180 hours and poisoning 57 hours. Twenty-two Properties required no poisoning but 660 ampoules of chloropicrin were used to fumigate warrens on them. No work was necessary on 5 properties.

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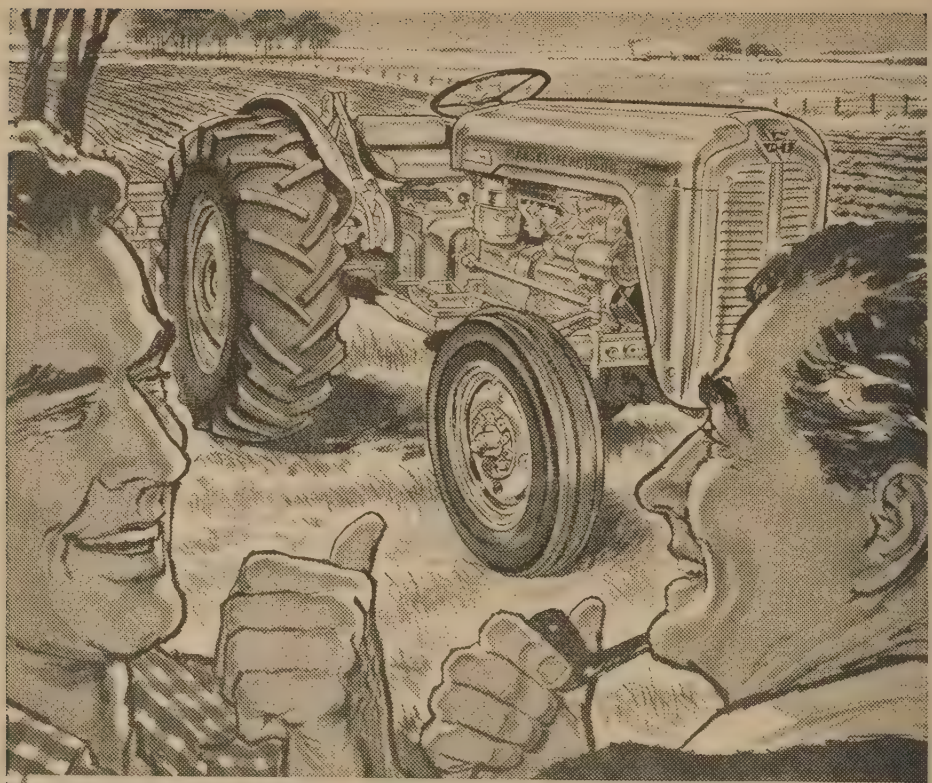
Do you know that the Department of Agriculture provides a comprehensive service of advice and technical assistance to farmers, free of charge?

When in need of advice, get in touch with your District Officer whose name and headquarters township will be found in the list of Departmental personnel on Pages 1042 and 1043.

These officers are there to help you and will make personal visits to your property to assist with on-the-spot advice. In addition, they will, where necessary, arrange for the services of specialist officers—all without cost to you.



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2720 Safflower—An Oil Crop for the Kimberleys—Feb., 1960.
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2759 Studies in the Mulga Pastoral Zone—1. The Grazing of Wandarrie Grass Associations—June, 1960.
2770 Studies in the Mulga Pastoral Zone—2. Some Aspects of the Value of Mulga Scrub—July, 1960.
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2596 Flax Variety Experiments at Bramley and Manjimup, 1955-57—Nov., 1958.
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2451 Control of Root-Knot or Eelworm by Soil Fumigation with D-D—Mar., 1958.
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2401 Seven Factors in Profitable Poultry Farming—Nov., 1956.
2423 Teaching Chickens to Perch—Jan., 1957.
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2504 Some Poultry Pests—Jan., 1958.
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GALAH POISONING

KILL THE "COCKY"

By J. L. LONG, Research Technician and F. VAGG, Regional Vermin Control Officer
(Agriculture Protection Board)

NO! Not the one that tills the land, but his enemy, the pink and grey galah (Kakatoe rosei-capilla). Farmers have usually found the destruction of galahs damaging standing crops and bagged, or stored grain, fairly difficult. Past methods of boiling grain and adding sweetened substances are rather laborious and require a lot of time. Now, a quick and relatively simple method is available to farmers, using paraffin oil to adhere poison to the grain.

Tests and trials have recently been conducted in the northern and eastern wheatbelt of W.A. with considerable success. The new method is to mix 1 oz. of powdered strychnine with 4-5 fl. ozs. of paraffin oil and apply the mixture to 10-16 lb. of grain. Both wheat and oat grains have been used, but as it is usual for the galah to shell the oats, wheat is preferred.

Results from this method are most encouraging. In June and July, 1960, at Beacon, Cleary and Wialki Sidings in the Eastern Wheatbelt, poisonings were carried out at the wheat bins, resulting in the destruction of some 1,500 galahs. These kills were estimated to be in the vicinity of 60 per cent. to 70 per cent. of the numbers present. It was also noted that approximately three grains of wheat poisoned in the manner described killed a galah in 15 minutes.

In the northern wheatbelt attempts have been made to poison galahs at such sites as dams, in ripe crops, in newly seeded paddocks and at bagged grain stacks awaiting carting at harvest time. Although a few birds have been killed prior to harvest time by placing poisoned grain close to the edges of crops where galah damage is evident at this time, they are usually more interested in feeding on the grain heads. Around dams and other watering places is not always the best place to conduct a poisoning. However, amongst small flocks results of 50 per cent. have been achieved at such localities. If baiting near water, poisoned grain can be placed out near a tree which is used as a roosting place by the birds as they pass to and fro.

Probably one of the best places to poison galahs on the farm is where bags of grain are stacked in the paddocks. If the stacks are covered with tarpaulins or bags (weighed down with weights to prevent it from flapping and blowing off) the birds can be free fed and poisoned by grain laid on top of the covers. There is no need to poison every stack as the birds soon find those with grain exposed on top.

Birds are often found feeding on freshly sown paddocks but efforts to attract them onto deliberately laid heaps of grain have so far been unsuccessful. Farmers claim that they are able to obtain good kills by broadcasting poisoned grain behind the seeder.

In general, for a successful galah poisoning, the birds must be concentrating regularly on a recognisable feeding ground **and must be** free fed for 2-3 days before any poison is laid if existing conditions at the site are altered.

SUMMARISING

The following mixture has been used successfully to poison galahs:—

10-16 lb. wheat.
4-5 fluid ounces of liquid Paraffin Oil.
1 oz. of powdered Strychnine.

The poison and oil are first mixed together and the resulting oily paste mixed evenly over the wheat. When all the galahs are feeding on unpoisoned wheat, the free feed is replaced by poisoned grain. If free feeding is carried out properly, a successful reduction in numbers should result.

JUDGING A HORSE'S AGE

A RHYMING REMINDER

This ancient doggerel (author unknown) provides a useful means of memorising the changes which take place in a horse's teeth as it grows from foalhood to old age.

To tell the age of any horse
Inspect the lower jaw of course.
The six front teeth the tale will tell
And all your doubts and fears dispel.

Two middle nippers you'll behold
Before the foal is two weeks old.
Before eight weeks two more will come.
Eight months the "corners" cut the gum.

Two outside grooves will disappear
From middle two in just one year.
In two years from the second pair
In three, the "corners" too are bare.

Nigh three the middle "nippers" drop,
Nigh four the second pair can't stop,
When rising five the third pair goes,
At five a full new set he shows.

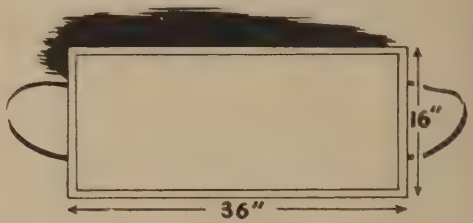
The deep black spots will pass from view
At six years from the middle two.
The second pair at seven years,
At eight the spot each corner clears.

From middle nippers, upper jaw
At nine the black spot will withdraw.
The second pair at ten are white.
Eleven finds the corners white.

As time goes on, the horseman knows,
Each oval tooth three-sided grows.
They longer get, project before,
Till twenty when we know no more.

MAKE A WOOD CARRIER

A useful addition to the household equipment and one which should be fully tested in this cold weather can be quickly made from a sugar-bag or piece of strong fabric. This is a wood carrier which enables an armful of wood to be carried without the usual accompanying dirty smudges on clothing.



To make this simple accessory take a sugar-bag or two pieces of hessian approximately 36 in. by 16 in. and machine or hand-stitch them together around the edges. On the shorter ends place loop handles.

To use the holder, place it on the ground and pile the wood in the centre. When the handles are pulled together, an open type of bag is formed. It can be loaded and emptied easily and hangs or packs in a small space when not in use.

PLANT DISEASES

SCALD OF BARLEY

By S. C. CHAMBERS, M.Sc., Plant Pathologist

SCALD is a common disease of barley during late winter-early spring and causes considerable damage to the foliage of many crops.

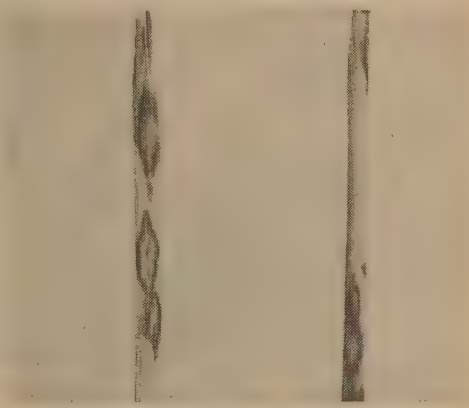
The fungus *Rhynchosporium secalis* is responsible for this disease which is very prevalent in all barley growing districts. Although no estimation of local losses has ever been made, an overseas report instances yields being reduced 20 per cent. following severe attacks by Scald.

Symptoms.—The disease first becomes evident as water soaked "scalded" areas of irregular shape on the leaves and sheaths. These blotches are greyish green in colour, but gradually turn light grey and develop a distinct brown margin. Premature death of much of the foliage occurs as the blotches continue to enlarge and coalesce.

Carry Over and Spread.—During periods of cool, wet weather in the late winter and early spring, numerous fungal seeds, called spores, are produced on infected crop residues from the previous year. These are carried about by wind into nearby barley crops and infect the new foliage. As cool, wet conditions continue, more spores are produced on the new blotches and the disease spreads through the crops.

In Western Australia, scald has been recorded only on barley, but overseas, the disease has been reported on many different hosts. The more important of these are certain species of rye, brome and barley grasses as well as cereal rye.

Recent work in the United States has shown that the disease may also be perpetuated on infected seed.



Blotches caused by barley scald

PREVENTION AND CONTROL

(1) Diseased residues from barley crops should be either burned or ploughed under at the earliest opportunity. This will prevent the production and dissemination of spores during the following season.

(2) If practicable, barley should be grown in paddocks, which are well separated from those cropped with this cereal during the previous season.

(3) Seed should be dry pickled with an organic mercury dust. This will control covered smut and may assist in the control of scald.

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*Patent Pending 55007/59.

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- **Steel Earth Ring.**

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2,000	£240	£22	£31
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BRANDING REGULATIONS

Sheep inspections prior to sales at Midland Junction and country centres indicate that many sheep-owners are not conversant with the provisions of the Brands Act, stated Mr. C. R. Toop, (Chief Veterinary Surgeon) of the Department of Agriculture.

Farmers and others appear to be under the impression that sheep carrying legible registered brands may be sold, even though the owner of the sheep is not the owner of a registered brand. Sheep dealers or any person owning sheep MUST also own a registered brand.

It has been found also that a considerable number of stockowners now trading as partnerships or companies are using brands which were registered by individuals. Even though the individual brand owner is a member of the partnership or company the use of his brand by the partnership or company is illegal. The correct procedure is to have the brand transferred, or to register a new brand.

A popular fallacy is that a brand is registered to a property and may be used by any person purchasing that property. Brands, in fact, are registered to a person for use on a particular property or properties and may not be used by anyone else unless and until they have been transferred through this Department.

Other requirements of the Brands Act are that sheep must be legibly marked with a registered woolbrand and earmarked with a registered earmark and that the use of black branding fluids is expressly forbidden.

The Brands Act regulations will continue to be strictly enforced at future sales and owners are advised to ensure that their brands are properly registered.

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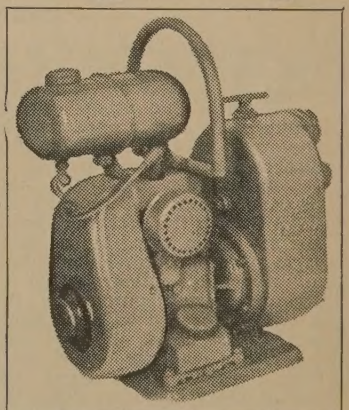

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